

## SPECIFICATIONS FOR WORKS

### GENERAL NOTES :

- i) The detailed specifications given hereinafter are for the items of works described in the schedule of quantities attached herein, and shall be guidance for proper execution of work to the required standards.
- ii) It may also be noted that the specifications are of generalised nature and these shall be read in conjunction with the description of item in schedule of quantities and drawings. The work also includes all minor details of construction which are obviously and fairly intended and which may not have been referred to in these documents but are essential for the entire completion in accordance with standard Engineering practice.
- iii) Unless specifically otherwise mentioned, all the applicable codes and standards published by the Indian Standard Institution and all other standards which may be published by them before the date of receipt of tenders, shall govern in all respects of design, workmanship, quality and properties of materials and methods of testing, method of measurements etc. Wherever any reference to any Indian Standard Specifications occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued there to or revisions thereof, if any, up to the date of receipt of tenders.
- iv) In case there is no I.S.I. specification for the particular work, such work shall be carried out in accordance with the instructions in all respects, and requirements of the Engineer-in-Charge. Wherever any reference to any Indian Standard Specification occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued there to or revisions thereof, if any, up to the date of receipt of tenders.
- v) The work shall be carried out in a manner complying in all respects with the requirements of relevant byelaws of the Municipal Committee/Municipal Corporation/Development Authority/Improvement Trust under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and, unless otherwise mentioned, nothing extra shall be paid on this account.
- vi) Samples of various materials, fittings etc. proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineer-in-charge before order for bulk supply is placed.
- vii) The contractor shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials in any place. No excavated earth or building materials shall be stacked on areas where other buildings, roads, services, compound walls etc. are to be constructed.
- viii) The contractor shall maintain in perfect condition all works executed till the completion of the entire work awarded to him. Where phased delivery is contemplated, this provision shall apply to each phase.
- ix) The contractor shall give a performance test of the entire installation(s) as per standard specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the test.
- x) The contractor shall clear the site thoroughly of all scaffolding materials and rubbish etc. left out of his work and dress the site around the building to the satisfaction of the Engineer-in-Charge before the work is considered as complete.
- xi) Post construction inspection and testing: After completion of the work and during maintenance period liability of the contractor, the work shall also be subjected to 'Post construction inspection and testing'. In case the materials or articles incorporated in the work are found to be inferior, though the sample collected for the same might have been passed at the time of execution, it shall be the responsibility of the contractor to replace the same at his own cost, failing which the Department may rectify the same at the risk and cost of the contractor or Department may accept the work as sub-standard, and cost be adjusted from the outstanding security deposit, as per the terms and conditions of the contract for the work.
- xii) The Engineer-G (Civil) shall be the sole deciding authority as to the meaning, interpretations and implications for various provisions of the specifications and his decision in writing shall be final and binding on all concerned.
- xiii) In case any difference or discrepancy between the specifications and the description in the schedule of quantities, the schedule of quantities shall take precedence. In case of any difference or discrepancy

# **PART - A**

## **SPECIFICATION FOR EARTHWORK IN GRADING, EXCAVATION AND BACK FILLING**

### **1. SCOPE**

This specification covers the general requirements of earthwork in excavation in different materials, site grading, filling in areas as shown in drawing, filling back around foundations and in plinths, conveyance and disposal of surplus soils or stacking them properly as shown on the drawings and as directed by the Engineer and all operations covered within the intent and purpose of this specifications.

### **2. APPLICABLE CODES**

The following Indian Standard codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to.

- |    |                  |   |  |
|----|------------------|---|--|
| a. | IS-783           | - | Code of practice for laying of concrete pipes.                                   |
| b. | IS-1200          | - | Method of measurement of building works.   |
| c. | IS-3764          | - | Safety code for excavation work.   |
| d. | IS-3385          | - | Code of practice for measurement of civil engineering works.                     |
| e. | IS-2720- Part II | - | Determination of Moisture content  |
|    | Part VII         | - | Determination of moisture Content - dry Density Relation using light compaction  |
|    | Part VIII        | - | Determination of Moisture Content - dry Density Relation using heavy compaction  |
|    | Part XX VIII     | - | Determination of Dry Density of soils, In-place, by the sand Replacement Method. |
|    | Part XXIX        | - | Determination of Dry Density of soils. In-place, by the Core Cutter Method       |

### **3. DRAWINGS**

Engineer-in-charge will furnish drawings, wherever, in his opinion, such drawings are required to show areas to be excavated/filled, sequence of priorities etc. Contractor shall follow strictly such drawings.

### **4. GENERAL**

4.1 Contractor shall furnish all tools, plants, instruments, qualified supervisory personnel, labour materials, any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein, for completion of the job in accordance with specification requirements.

4.2 Contractor shall carry out the survey of the site before excavation and set properly all lines and establish levels for various works such as earthwork in excavation for grading, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to establish reference/grid lines at 6 m. intervals or nearer as determined by the Engineer based on ground profile. These shall be checked by the Engineer and thereafter properly recorded.

4.3 The Excavation shall be done to correct lines and levels. This shall also include, where required, proper shoring to maintain excavation and also include, where required, proper shoring to maintain excavation and also the furnishing, erecting and maintaining of substantial barricades around excavated area and warning lamps at night for ensuring safety.

4.4 The rates quoted shall also include for clearing the site as per point no. 5 below, dumping of excavated materials in regular heaps, bunds, riprap with regular slopes as directed by the Engineer, within the lead specified and levelling the same so as to provide natural drainage. Rock/soil excavated shall be stacked properly as directed by the Engineer, AS a rule, all softer materials shall be laid along the centre of the heaps, the harder and more weather resisting the casing on the sides and the top. Rock shall be stacked separately.

## **5. CLEARING**

The area to be excavated filled shall be cleared of fences, trees, plants, log stumps, bush vegetation, rubbish slush etc., and other objectionable matter. If any roots or stems of trees found during excavation, they shall also be removed. Trees, if any, shall not be uprooted or cut without the prior approval of the Engineer. The material so removed shall be burnt or disposed-off as directed by the Engineer. Useful materials. Saleable timber, firewood, etc., shall be stacked properly at the site in a manner directed by the Engineer. Where earth fill is intended, the area shall be stripped of all loose/soft patches, top soil containing objectionable matter/ materials before fill commence. The contractor shall include in the rates of excavation of the schedule of quantities and prices for all clearing grubbing and uprooting and cutting of trees wherever required for the works.

## **6. PRECIOUS OBJECTS, RELICS, OBJECTS OF ANTIQUITY, ETC.**

All gold, silver, oil, minerals, archaeological and other findings of importance, tees cut or other materials of any description and all previous stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of the Department and Contractor shall duly preserve the same to the satisfaction of the Department and from time to time deliver the same to such person or persons as the Department may from time to time authorise or appoint to receive the same.

## **7. CLASSIFICATION**

All materials to be excavated shall be classified by the Engineer, into one of the following classes and shall be paid for at the rate tendered for that particular class of material. No distinction shall be made whether the materials is dry, moist or wet. The decision of the Engineer regarding the classification of the material shall be final and binding on contractor and not be a subject matter of any appeal or arbitration.

7.1 Any earthwork will be classified under any of the following categories.

### **a) Ordinary and Hard soils**

These shall include all kinds of soils containing kankar, sand, silt, murrum and/or shingle, gravel, clay, loam, peat, ash, shale, etc. which can generally be excavated by spade, pick axes and shovel and which is not classified under "soft and decomposed rock" and "hard rock" defined below. This shall also include embedded rock boulders not loner than 1 metre in any direction and not more than 200 mm in any one of the other two directions.

**b) Soft and decomposed Rock**

This shall include rock, boulders, slag, chalk, slate, hard mica schist, laterite and all other materials which in the opinion of the Engineer is rock, but does not need blasting and could be removed with picks, hammer, crow bars, wedges and pneumatic breaking equipment. The mere fact that contractor resorts to blasting for reasons of his own, shall not qualify for classification under "hard rock"

This shall also include excavation in macadam and tarred roads and pavements and shall also include rock boulders not loner than 1 metre in any direction and not more than 500 mm in any one of the other two directions. Masonry to be dismantled will also be measured under this item.

**c) Hard Rock**

This shall include all rock occurring in large continuous masses which cannot be removed except by blasting for loosening it. Harder varieties of rock with or without veins and secondary minerals which, in the opinion of the Engineer required blasting shall be considered as hard rock. Boulders of rock occurring in such sizes and not classified under (a) and (b) above shall also be classified as hard rock. Concrete work both reinforced and unreinforced to be dismantled will be measured under this item, unless a separate provision is made in the Schedule of Quantities.

**8. EXCAVATION**

8.1 This section shall include all work involved in site grading excavation for equipment foundations, column and wall footings, roads, trenches for surface drainage, pipes, manholes etc. stockpiling, disposal of surplus excavated material to spoil areas, clearing of excavations and dewatering and such other related work as directed by the Engineer.

8.2 Excavation for permanent work shall be taken out to such widths, lengths, depths and profiles as are shown on the drawing or such oilier lines and grades as may be specified by the Engineer. Rough excavation shall be carried out to a depth of 150 mm above the final level. The balance shall be excavated with special care. Soft pockets shall be removed even below the final level and extra excavation filled up as directed by the Engineer. The final excavation if so instructed by the Engineer, should be carried out just prior to laying the mud-mat.

8.3 Contractor may, for facility of work or similar other reasons excavate, and also backfill later, if so approved by the Engineer, at his own cost, outside the lines shown on the drawings or as directed by the Engineer. Should any excavation be taken below the specified elevations, contractor shall fill it up, with concrete of the same class as in the foundation resting thereon, up to the required elevation. **No extra shall be claimed by contractor on this account.**

8.4 All excavation shall be done to the minimum dimensions as required for safety and working facility. Prior approval of Engineer, shall be obtained by contractor in each individual case, for the method he proposes to adopt for the excavation, including dimensions, side slopes, dewatering, disposal, etc. This approval, however, shall not in any way relieve contractor of his responsibility for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. Side slopes shall be as steep as will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope. Removal of the slipped earth will not be paid for if the slips are due to the negligence of contractor.

8.5 Excavation shall be carried out with such tools, tackles and equipment as described hereinbefore. Blasting or other methods may be resorted to in the case of hard rock; however not without the specific permission of the Engineer.

8.6 The Engineer may also direct that in some extreme cases, the rock may be excavated by heating and sudden quenching for splitting the rock. Fire wood shall be used for burning and payment shall be made for such work as called for in the schedule of quantities.

## **9. STRIPPING LOOSE ROCK**

All loose boulders, semi-detached rocks (along with earthy stuff which might move therewith) not directly in the excavation but so close to the area to be excavated as to be liable, in the opinion of the Engineer, to fall or otherwise endanger the workmen, equipment, or the work etc. shall be stripped off and removed away from the area of the excavation. The method used shall be such as not to shatter, or render unstable or unsafe the portion which was originally sound and safe.

Any material not requiring removal as contemplated in the work, but which, in the opinion of the Engineer, is likely to become loose or unstable later, shall also be promptly and satisfactorily removed as directed by the Engineer. The cost of such stripping will be paid for at the unit rates accepted for the class of material in question.

### **STOCK PILES:**

All excavated materials shall be stocked piles at approved locations, until their use is authorised by the Engineer. Contractor rate shall include the work for stock piling and reloading and hauling of materials to its final position in the work. Stock piles shall have slopes not steeper than 1 : 1 and shall be placed so that natural drainage of the surrounding area will not be restricted.

## **10. FILL, BACK FILLING AND SITE GRADING**

### **10.1 GENERAL**

All fill material will be subject to the Engineer's approval. If any material is rejected by the Engineer. Contractor shall remove the same forthwith from the site at no extra cost to the Owner. Surplus fill material shall be deposited/disposed-off as directed by the Engineer after the filling work is completed.

No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise deal with as directed by the Engineer.

### **10.2 MATERIAL**

To the extent available, selected surplus spoils from excavated materials shall be used as back fill. Fill material shall be free from clods, salts, sulphates, organic or other foreign material. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murrum or earth to fill up the voids and the mixture used for filling.

10.3 If any selected fill material is required to be borrowed, contractor shall make arrangements for bringing such material from outside borrow pits. The material and source shall be subject to prior approval of the Engineer. The approved borrow pit area shall be cleared of all bushes, roots of trees, plants, rubbish etc. top soil containing salts/sulphates and other foreign material shall be removed. The materials so removed shall be burnt or disposed-off as directed by the Engineer. Contractor shall make necessary access roads to borrow areas and maintain the same, if such access road does not exist at his cost.

#### **10.4 FILLING IN PITS AND TRENCHES AROUND FOUNDATION OF STRUCTURES, WALLS ETC.**

As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches, etc., shall be cleared of all debris and filled with earth in layers not exceeding 150 mm. each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of the Engineer. Earth shall be rammed with approved mechanical compaction machines. Usually no manual compaction shall be allowed unless the Engineer is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and levelled to proper profile as directed by the Engineer or indicated on the drawings.

#### **10.5 EXCAVATION IN HARD ROCK**

**10.5.1:** Unless otherwise stated herein I.S. Specification "IS-4081 Safety Code for Blasting and Related Drilling Operation" shall be followed. After removal of overburden if any excavation shall be continued in rock to such widths, lengths, depths and profiles as are shown on the drawings or such other lines and grades as may be specified by the Engineer. As far as possible all blasting shall be completed prior to commencement of construction. At all stages of excavation, precautions shall be taken to preserve the rock below and beyond the lines specified for the excavation, in the soundest possible condition, the quantity and strength of explosive used, shall be such as will neither damage nor crack the rock outside the limits of excavation. All precautions, as directed by the Engineer shall be taken during the blasting operations and care shall be taken that no damage to permanent or temporary structures, contractor shall repair the same to the satisfaction of the Engineer at his/ their cost. As excavation approaches its final lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced.

**10.5.2:** Specific permission of the Engineer will have to be taken by contractor for blasting rock and he shall also obtain a valid blasting licence from the authorities concerned. If permission for blasting is refused by the Engineer the rock shall be removed by wedging, pick, barring, heating and quenching or other approved means. All loose or loosened rock in the sides shall be removed by barring, wedging etc. The unit rates for excavation in hard rock shall include the cost of all those operations.

**10.5.3:** It is contractor's responsibility to obtain necessary licence for storage and use of explosives for the work from the authorities dealing with explosives. The fees, if any, required for obtaining such licence shall be borne by contractor. Contractor shall have to make necessary storage facilities for the explosives as per rules of Local, state and Central Government authorities and statutory bodies/regulations. Explosives shall be kept dry and shall not be exposed to direct rays of sun or be stored in the vicinity of fire, stoves, steam pipes or heated metal, etc. No explosive shall be brought near the work in excess of quantity required for a particular amount of firing to be done and surplus left after filling the holes shall be promptly removed the magazine which shall be kept securely locked when not in use. The magazine should be built as far as possible from the area to be blasted. The Engineer's prior approval shall be taken for the location proposed for the magazine. The contractor shall construct a storage magazine for storage of explosives and detonators as per the regulations of Government of India. No matches or inflammable materials shall be allowed in the magazine. The magazine shall have an effective lightning conductor and the same shall be tested from time to time. The following shall be displayed as follows.

- a. A copy of rules in English, Hindi and in the language with which the workers are familiar.
- b. A statement of up-to-date stock in the magazine.
- c. A certificate showing the last date of testing of the lightning conductor.
- d. A notice that smoking is strictly prohibited.

#### **10.5.4: FOR BLASTING OPERATIONS, THE FOLLOWING POINTS SHALL BE OBSERVED.**

Contractor shall employ a competent and experienced supervisor and licensed blaster in charge of each set of operation who shall be held personally responsible to ensure that all safety regulations are carried out.

Before any blasting is carried out, contractor shall intimate the Engineer and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.

Contractor shall ensure that all workmen and the personnel at site are excluded from an area within 200 m. radius from the firing point at least 15 minutes before firing time by sounding warning siren. The area shall be encircled by red flags. Clearance signal shall also be sounding a distinguishing siren.

The blasting of rock near any existing buildings, equipment or any other property temporary/permanent shall be done under cover and contractor has to make all such necessary muffling arrangements as stated hereinafter under "Controlled blasting" Blasting shall be done with small charges only and where directed by the Engineer, a trench shall have to be cut by chiselling prior to the blasting operation separating the area under blasting from the existing structures.

The firing shall be supervised by a supervisor and not more than 6 holes at a time shall be set off successfully. If the blasts do not tally with the number fired, the misfired holes shall be carefully located after half an hour and when located shall be exploded by drilling a fresh hole along the misfired hole (but not nearer than 600 mm from it) and by exploding a new charge.

A wooden tamping rod with a flat end shall be used to push cartridges home and metal rod or hammer shall not be permitted. The charge shall be placed firmly into the place and not rammed or pounded. After a hole is filled to the required depth, the balance of the hole shall be filled with stemming which may consist of sand or stone dust or similar inert material.

The explosives shall be exploded by means of a primer which shall be fired by a fuse instantaneous detonator (F.I.D.) or other approved cable. The detonators with F.I.D. shall be connected by special nippers. In dry weather and normal dry excavation, ordinary low explosive gun powder may be used on specific approval only. In damp rock, high explosives like gelatine detonators and fuse wire may be used. In underwater or excavation with substantial seepage causing accumulation, and electric detonation shall be used.

Contractor shall preferably fire the explosives - electrically. Holes for charging explosive shall be drilled with pneumatic drills, the drilling pattern being so planned that rock pieces after blasting will be suitable for handling with our resorting to secondary blasting. Pattern of drill holes shall be got approved from the Engineer.

**Where excavation has almost reached the desired level, hand trimming shall have to be done for dressing the surface to the desired level. Any rock excavation beyond an over break limit of 75 mm shall be filled up as instructed by the Engineer, with concrete of strength not less than M 100. The cost of filling such excess depth shall be borne by contractor and the excavation carried out beyond the limit specified above will not be paid for. Stepping in rock excavation shall be done by hand trimming.**

Contractor shall be responsible for any accident to workmen, public or Dept.'s property due to blasting operations. Contractor shall also be responsible for strict observance of rules, laid down by Inspector of explosives or any other Authority duly constituted under the State and/or Union Government.

#### **10.5.5.: CONTROLLED BLASTING INSTRUCTIONS**

Rock blasting shall be carefully controlled so that rock pieces do not fly out of the pits and thus endanger the installations around. Contractor shall follow the detailed procedure as given below and carefully watch the blasting operations. Based on observations he should set his norms for quantities of charge, depth of holes etc. in consultation with the Engineer-in-charge within the limits specified below.

**Material for the charge-Gunpowder:** The ingredients of the gunpowder shall be of best available quality. The composition shall be as per manufacturer's specification meant specifically for rock blasting. The same shall be of best make and approved by the Engineer-in-charge before actual use.

**Quantity of charge:** Initially 75-80 mm of charge fill shall be used and observations made whether blasting is under full control. If necessary the charge may be gradually increased to 150 mm.

Depth of Hole - 150 to 1650 mm

Dia. Of Hole - 30 to 40 mm

Embedment of fuse inside charge - Fuse end shall be embedded to a depth of 1/2 to 2/3 of the depth of the charge.

Distance of firing end of the fuse from the charge - 15 m to 30 m

Time of blast after firing the fuse - 120 sees. to 150 secs.

Disposition of holes - 1.2 m to 1.8 m apart both ways.

Inclination - Inclination of the hole to be pointed towards the non-developed side of the site.

Number of holes to be taken up per blast - Minimum - 8 unless otherwise directed by  
Engineer-in-Charge.

Maximum - 20

**PROTECTIVE MEASURE:**

1) In no case shall blasting be allowed closer than 30 meters to any structure or to locations where concrete has just been placed. In the latter case the concrete must be at least 7 days old. Within 48 hours after concreting up to 100 meter, no blasting is permitted. When blasting is necessary adjacent to partial or completely built structures, the contractor shall take all precautions necessary to prevent flying rock from causing damage to the structures.

2) During concreting (any time) beyond 100 meters, blasting only with 2 Kg. / delay.

3) 24 hrs. after concreting beyond 100 meters up to 14 kg/delay.

<u>Distance from structures</u>	<u>blasting limits</u>
30 meters	4 kg/delay
45 "	7 "
100 "	14 "
200 "	27 "

4) The holes are to be covered with 0.6 sq.m to 1 sqm. steel plates 3 mm thick or ten gauge thick



- 5) Over the steel plates mesh shall be placed of reinforcement rod mesh not less than 20 mm dia @ 150 centres.
- 6) Sand filled bags of 6 layers to 8 layers shall be placed over the mesh suitably covering the whole region under blasting operations.

The reinforcement mesh shall be inspected after every operation and all twists shall be removed before reuse to the satisfaction of the Engineer.

#### **FEEDING THE CHARGE:**

- a) Bottom 50 to 75 mm of the hole shall be filled with dry powder.
- b) Then the gunpowder shall be fed into the hole to the desired length and lightly tamped with a rod.
- c) The fuse wire shall then be inserted to a depth of 1/2 to 2/3 the depth of the charge.
- d) The rest of the hole shall now be filled with dry brick powder or dry murrum.

Precautions to be taken when the water label is encountered.

When the drilled hole encounters water, the charge shall be fed into a steel tube or a plastic tube and inserted to the bottom of the hole.

#### **CLEANING EXCAVATION :**

Excavation shall be cleaned & trimmed and all disturbed materials and other debris and water shall be removed. When the excavations have been taken out to the lines specified or shown on the drawings in the surfaces cleaned as specified, the contractor shall notify the Engineer that the excavation is ready for inspection and no further work shall be carried out until the excavation has been inspected and approved by the Engineer.

#### **DEWATERING :**

The contractor shall ensure that the area has been excavated is kept in reasonably dry condition not only during excavation but also after completing excavation till such time when concrete/masonry or filling work is completed.

#### **PROPRIETARY RIGHTS :**

All the excavated materials shall be the property of the Government and if the contractor wants to use it for his/their works, he/they shall obtain permission from Government at a mutually agreed rate.

#### **10.6. ROCKFILL:**

##### **10.6.1 MATERIAL :**

Rockfill shall consist of hard durable sandstone excavate from the site or from other sources approved by the Engineer.

##### **10.6.2 GRADING:**

Except as specified elsewhere, rock till shall be quarry run with no special grading limits necessary, other than the maximum size of any one piece shall not be more than one half the depth of the fill at the location Placed.

##### **10.6.3. PLACING :**

Rockfill may be placed using mechanical equipment or by hand placing.

#### **10.6.4. COMPACTION :**

Compaction shall be done by 10-12 T vibratory compactor or roller and by the use of water so that each layer not exceeding 300 mm, of rockfill placed is sluiced with sufficient volume of water to settle and compact the finer particles of rock. Any settlements which have occurred after the rock fill has been placed for a period of time shall be rectified by the contractor by placing additional fill to the specified grade.

#### **10.6.5. PAYMENT:**

No separate payment shall be made for rock fill.

### **10.7 PLINTH FILLING**

**10.7.1** Plinth filling shall be carried out with approved material as described hereinbefore in layers not exceeding 150 mm. Watered and compacted with mechanical compaction machines. The Engineer may however permit manual compaction by hand tampers in case he is satisfied that mechanical compaction is not possible. When filling reaches the finished level, the surface shall be flooded with water, unless otherwise directed, for at least 24 hours, allowed to dry and then the surface again compacted as specified.

**10.7.2.** Where specified in the schedule of works, compaction of the plinth fill shall be arrived out by means of 12 tonne rollers smooth wheeled, sh<sup>o</sup>ep foot or wobbly wheeled rollers. A smaller weight roller may be used only if permitted by the Engineer-in-charge. As rolling proceeds water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fill. The thickness of each unconsolidated fill layer can in this case be upto a maximum of 300 mm. The Engineer will determine the thickness of the layers in which fill has to be consolidated depending on the fill material and equipment used.

Rolling shall commence from the outer edge and progress towards the centre and continue until compaction is to the satisfaction of the Engineer, but in no case less than 10 passes of the roller will be accepted for each layer.

The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated and filled and consolidated.

At some locations/areas it may not be possible to use rollers because of space restrictions etc. Contractor shall then be permitted to use pneumatic tampers, rammers etc. and he shall ensure proper compaction.

### **10.8 SAND FILLING IN PLINTH AND OTHER PLACES**

At places backfilling shall be carried out with local sand if directed by the Engineer. The sand used shall be clean, medium grained and free from impurities. The filled in sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. Any temporary work required to contain sand under flooded condition shall be to contractor's account. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Engineer has inspected and approved the fill.

### **10.9 FILLING IN TRENCHES**

**10.9.1** Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipe and drains have been tested and passed. The backfilling material shall be properly consolidated by watering and ramming, taking due care that no damage is caused to the pipes.

**10.9.2** Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the centre line of the pipe shall be done by hand compaction with selected approved earth in layers not exceeding 80 mm backfilling above the level of the centreline of the pipe shall be done with selected earth by hand compaction or other approved means in layers not exceeding 150 mm.

**10.9.3** In case of excavation of trenches in rock, the filling upto a level of 300 mm, above the top of the pipe shall be done with fine materials, such as earth murrum etc. The filling up of the level of the centreline of the pipe shall be done by hand compaction in layers not exceeding 80 mm. Whereas the filling above the centreline of the pipes shall be done by hand compaction or approved means in layers not exceeding 150 mm. The filling from a level 300 mm, above the top of the pipe to the top of the trench shall be done by hand or other approved mechanical methods with broken rock filling of size not exceeding 150 mm. mixed with fine material as available to fill up the voids.

**10.9.4** Filling of the trenches shall be carried simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

## **11. GENERAL SITE GRADING**

**11.1** Site grading shall be carried out as indicated in the drawings and as directed by the Engineer, excavation shall be carried out as specified in the specification. Filling and compaction shall be carried out as specified under clause 10 and elsewhere unless otherwise indicated below.

**11.2** If no compaction is called for, the fill may be deposited to the full height in one operation and levelled. If the fill has to be compacted, it shall be placed in layers not exceeding 225 mm and levelled uniformly and compacted as indicated in clause 10 before the next layer is deposited.

**11.3** To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by owner if required, **the cost of which shall be borne by the Contractor.**

**11.4** Field compaction test shall be carried out at different stages of filling and also after the fill to the entire height has been completed. This shall hold good for embankments as well. **The cost of which shall be borne by the Contractor.**

**11.5** Contractor shall protect the earthfill from being washed away by rain or damaged in any other way. Should any slip occur, contractor shall remove the affected material and make good the slip at his cost.

**11.6** The fill shall be carried out to such dimensions and levels as indicated on the drawings after the stipulated compaction. The fill will be considered as incomplete if the desired compaction has not been obtained.

**11.7** If specifically permitted by the Engineer, compaction can be obtained by allowing loaded trucks conveying fill or other material to ply over the fill area. Even to demonstrate that the desired/specified composition has been obtained. In order that the fill may be reasonably uniform throughout the material should be dumped in place in approximately uniform layers. Traffic over the fill shall then be so routed to compact the area uniformly throughout.

**11.8** If so specified, the rock as obtained from excavation may be used for filling and levelling to indicated grades without further breaking. In such an event, filling shall be done in layers not exceeding 500 mm approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth broken stone, etc. and the area flooded so that finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12 tonne roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.

## **12. FILL DENSITY AT SITE**

The compaction, only where so called for, in the schedule of quantities/items shall comply with the specified (proctor/modified proctor) density at moisture content differing not more than 4 percent from the optimum moisture content. Contractor shall demonstrate adequately by field and laboratory tests that the specified density has been obtained. The cost of which shall be borne by the Contractor.

## **13. LEAD**

Lead for deposition/disposal of excavated material, shall be as specified in the respective item of work. For the purpose of measurement of lead, the area to be excavated or filled or area on which excavated material

is to be deposited/disposed off shall be divided into suitable blocks and for each of the blocks, the distance between centre lines shall be taken as the lead which shall be measured by the shortest straight line route on the plan and not the actual route taken by contractor. No extra compensation is admissible on the grounds that the lead including that for borrowed material had to be transported over marshy or "katcha" land/route.

## **14. MEASUREMENT AND PAYMENT**

**14.1** All excavation shall be measured net, dimensions for purpose of payment shall be reckoned on the horizontal area of the excavation at the base for foundations of the walls, columns, footings, tanks, rafts, or other foundations/structures to be built, multiplied by the mean depth from the surface of the actual level of concerned ground in accordance with the drawings. Excavation in side slopes will not be paid for. Contractor may make such allowance in his rates to provide for excavation in side slopes keeping in mind the nature of the soil and safety of excavation. Reasonable working space, beyond concrete dimensions and shuttering, where considered necessary in the opinion of the Engineer and shown in the tender drawing will be allowed in excavation and considered for payment. However, if concreting is proposed against the excavated sides, no such over-excavation will be permitted. In such cases over-excavation shall be made good by contractor with concrete of the same class as in the foundations at his cost.

For the purpose of measurement of quantities for the lead: quantities of earth paid under excavation will only be considered for payment.

Volume of rock excavated shall be calculated on the basis of length, breadth at the base and depth of excavation indicated on the drawings. No payment will be made for excavation/over-break beyond payment lines specified as above. Where such measurement is not possible, as in the case of strata intermixed with soil, excavated rock shall be properly stacked as directed by the Engineer and the volume of rock calculated on the basis of stack measurements after making appropriate allowance for voids. The allowance to be made for voids shall be decided by the Engineer and this will not be a subject matter of dispute or appeal.

The rate for excavation shall also include the carting away the excavated rock for deposition to the required lead as indicated in the item of work and properly stacking the same as directed by the Engineer. The rate quoted by the contractor shall be inclusive of the cost of all explosives and additional cost if any involved in the protective measures as stipulated in para 4 of specifications for controlled blasting.

**14.2** Unless otherwise specified, the unit rates quoted for excavation in different type of materials shall also account for a basic lead of 50 meters for disposal as specified or as directed. Only leads beyond the basic lead of 50 meters will be considered as extra lead and paid for at the rates quoted in the schedules.

**14.3** Backfilling as per specification the sides of foundations, of columns, footings, structures, walls, tanks, rafts, treches etc. with excavated material will not be paid for separately. It shall be clearly

understood that the rate quoted for excavation including backfilling shall include stacking of excavated material as directed, excavation/picking of selected stacked material, conveying it to the place of final backfill, compaction etc. as specified. As a rule material to be backfilled shall be stacked temporarily within the basic lead of 50 meters unless otherwise directed by the Engineer.

**14.4** Payment for fill inside trenches, plinth or similar filling with selected excavated material will be made for only compactions as specified/directed. Cost of all other operations shall be deemed to have been covered in the rate quoted for excavation. Payment for this work will be made based on measurement of plinth/trench dimensions filled. The plinth ground levels shall be surveyed before-hand for this purpose. If no compaction is specified/desired such filling will not be separately paid for. In such a event the fill shall be levelled/finished to the profile as directed at no extra cost.

**14.5** Backfilling, plinth filling etc. with borrowed earth will be paid for at rates quoted. The quoted rate shall include all operations such as clearing, excavation, lead and transport , fill compaction etc., as specified. Actual quantity of consolidated filling limited to the dimensions considered for payment for excavation only shall be measured and paid for in cubic meters. The lead, lift, etc. shall be as indicated in the schedule of quantities.

**14.6** Actual quantity of consolidated sand filling shall be measured and paid in cubic metres.

**14.7** Whenever required contractor has to carry out field density tests under department's supervision and entire cost of the same is deemed to be included in the rate of excavation of earth/filling

## **15. DEWATERING**

### **15.1 SCOPE**

The scope of work under this specifications comprises dewatering during the progress of excavation till the same is completed upto the plinth.

**15.2** All excavation shall be kept free of water. Grading in the vicinity of excavation shall be controlled to prevent surface water running into excavated area. Necessary bund and surface drains shall be provided by the contractor. So that no surface water shall enter into the excavated pit for the foundations. Contractor shall remove by pumping or other means approved by the Engineer any water inclusive of rain water and subsoil water accumulated in excavation and keep all excavation dewatered (until the completion of excavation). Sumps made for dewatering must be kept clear of the excavation / trenches required for further work. Method of pumping shall be approved by the Engineer, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction.

**15.3** When there is a continuous in-flow of water and quantum of water to be handled is considered in the opinion of the Engineer-in-charge. Contractor shall submit to the Engineer his proposal regarding the number, capacity and location of pumps for approval.

**15.4** The rate for excavation in soils, soft rock and hard rock shall be inclusive of dewatering charges.

# **PART -B**

## **SPECIFICATION FOR SUPPLY AND FABRICATION OF STRUCTURAL STEEL**

### **1. SCOPE**

**1.1** This specification covers requirements for supply where specified, fabrication and delivery at site of structural and miscellaneous steel for the project.

**1.2** This specification also covers redesign where necessary, design of all connection and substituted members, preparation of all shop fabrication drawings, inspection and painting of structures by the fabricator.

### **(A) MATERIALS ( All latest edition only)**

1. IS : 226 - Structural steel (standard Quality)
2. IS : 808 - Rolled steel beam, channel and angle sections
3. IS : 961 - Structural steel (high tensile)
4. IS : 2062 - Structural steel (Fusion welding quality)
5. IS : 1977 - Structural steel (ordinary quality)
6. ASTM A 6 - General Requirements for delivery of rolled steel plates, shapes, sheet piling and bars for structural use.
7. IS : 1148 - Rivet bars for structural purposes.
8. IS : 1149 - High tensile rivet bars for structural purposes.
9. IS : 1363 - Black Hexagon bolts, nuts and lock nuts (diameter 6 to 39 mm) and black hexagon screws (diameter 6 to 39 mm)
10. IS : 1364 - Precision and semi-precision hexagon bolts screws, nuts and lock nuts (diameter 6 to 39 mm)
11. IS : 1367 - Technical supply conditions for threaded fasteners
12. IS : 3757 - High Tensile friction grip fasteners for structural engineering purposes.
13. BS : 1083 - Precision Hexagonal bolts, screws and nuts (BSW & BSF Threads)
14. BS : 3139 - High strength friction grip bolts for structural engineering.
15. ASTM A 325 - High strength steel bolts for structural joints
16. IS : 2016 - Plain washers
17. IS : 814 - Specifications for Covered electrodes for metal arc welding for mild steel.
18. IS : 3613 - Acceptance tests for wire flux combination for submerged arc welding

- |     |           |   |   |
|-----|-----------|---|---|
| 19. | BS : 639  | - | Covered Electrodes for the manual metal arc welding of mild steel and medium tensile steel. |
| 20. | AWS A-5.1 | - | Specification for Mild Steel covered Arc welding Electrodes.                                |
| 21. | AWS A-5.1 | - | Specification for Bare Mild Steel Electrodes and fluxes for submerged arc welding.          |
| 22. | IS : 1852 | - | Specification for Rolling and cutting Tolerances for Hot Rolled steel products.             |
| 23. | IS : 2074 | - | Ready Mixed Paint, Red Oxide Ainc Chrome priming  |
| 24. | IS : 102  | - | Ready mixed Paint, Brushing, Red Lead, nonsetting. Priming.                                 |

**(B) CODES OF PRACTICE**

- |     |           |   |  |
|-----|-----------|---|--|
| 1.  | IS : 800  | - | Code of Practice for use of structural steel in general building construction.   |
| 2.  | IS : 875  | - | Code of Practice for structural Safety of Building Loading Standards.  |
| 3.  | IS : 1893 | - | Recommendations for Earthquake Resistant Design of Structures.   |
| 4.  | BS : 449  | - | The Use of Structural Steel in Building  |
| 5.  | AISC :    | - | Specification for the Design, Fabrication and Erection of Structural Steel for Buildings                                     |
| 6.  | IS : 919  | - | Recommendations for limits and fits for Engineering  |
| 7.  | IS : 4000 | - | Code of Practice for liquid Penetrant flow Detection   |
| 8.  | BS : 3294 | - | The use of High Strength Friction Grip Bolts in Structural Steel - Works   |
| 9.  |           | - | Research Council on Riveted and Bolted Structural Joints – Specification for Structural Joints using ASTM A 325 or 490 Bolts |
| 10. | IS : 816  | - | Code of Practice for use of Metal Arc Welding for General Construction   |
| 11. | IS : 4353 | - | Recommendations for Submerged Arc Welding of Mild Steel and Low Alloy Steels   |
| 12. | AWS :     | - | Standard Cod of Welding in building construction   |
| 13. | IS : 823  | - | Code of procedure for Manual Metal Arc Welding of Mild Steel.  |
| 14. | IS : 817  | - | Code of Practice for Training and Testing of Metal Arc Welders.  |
| 15. | IS : 1181 | - | Qualifying Tests for Metal Arc Welders (Engaged in welding structures other than pipes)                                      |
| 16. | IS : 1182 | - | Recommended Practice for Radiographic examination of Fusion – Welded Butt Joints in steel plates                             |

17. IS : 3658 - Code of Practice for Liquid Penetrant flow Detection.
18. IS : 5334 - Code of Practice for Magnetic Particle Flow Detection of Welds.
19. ASTM E 94 - Recommended Practice for Radiographic Testing
20. ASTM E 109 - Dry Powder Magnetic Particle Inspection
21. ASTM E 138 - Wet Magnetic Particle Inspection
22. ASTM E 165 - Liquid Penetrant Inspection
23. IS : 1477 - Code of Practice for painting of ferrous metals in building and allied finishes.

### **3. STEEL MATERIALS**

Steel materials shall comply with the specifications laid down under clause 2.0 and/or as called for on the design drawings.

#### **3.1 STEEL SUPPLIED BY PURCHASER**

**3.1.1** When steel is supplied by the Purchaser, it will be supplied expurchaser's store in such condition and in such lengths/sizes as are available in stock or as received from the steel mills.

**3.1.2** On receiving each consignment of steel from the purchaser, the contractor shall acknowledge in writing the receipt thereof giving full particulars of sections, sizes, quantities, grade and quality should there be any damage or distortion of the materials in transit the contractor shall immediately report the matter to the Engineer.

**3.1.3** Contractor shall take proper care of the steel supplied by Purchaser and protect the same from weathering and damage. Any such materials rendered unserviceable or damaged while in the contractor's custody shall be replaced or repaired by contractor at his/their own cost as determined by the Engineer.

#### **3.2 STEEL SUPPLIED BY CONTRACTOR**

**3.2.1** Contractor shall furnish Purchaser/Engineer duplicate copies of all mill orders covering the material ordered by him for this project and also the test reports received from the mills for purchaser's/Engineer's check and information.

**3.2.2** It is not the intention of the purchaser that all the steel materials to be supplied by contractor for the work shall be specially purchased from rolling mills. Contractor's stock material may be used provided the mill test reports identified with the materials, satisfactorily demonstrate specified grade and quality. Also all such materials supplied by contractor shall be in a sound condition of recent manufacture, free from defects, loose mill scale, slag intrusions, laminations, pitting, flaky, rust etc. and be of full weight or thickness specified. Thi lengths/sizes of steel sections and plates shall be as supplied by the steel mills. Such materials shall be indicated by the Contractor separately.

**3.2.3** Unidentified stock materials may be used, only with prior permission from the Engineer in Writing, for short sections of minor importance or for small unimportant works and connections where, in the opinion of the Engineer, the quality of such materials would not adversely affect the strength and/or durability of the structure. Engineer may also permit we of such material for other works if adequate random samples taken out and tested to demonstrate conformity with specification and requirement for the work in view.



#### **4. SUBSTITUTIONS**

**4.1** Wherever contractor, in order to accommodate his/other material in stock, desires to substitutions structural shapes or plates for the sizes shown on drawings, such substitutions shall be made only after, written approval of Engineer-in-Charge. Payment shall however be made as per approved working drawing prior to requested substitution, or new section whichever has lower sectional weight.

**4.2** The Engineer may also direct that substitution be made, where he considers such substitutions to be necessary.

#### **5. USE OF STEEL SUPPLIED BY PURCHASER**

Contractor(s) shall use steel supplied by purchaser judiciously and to the best advantage so as to minimize splicing and wastage, contractors) shall submit his/their cutting lists for the Engineer's approval before fabrication commenced and make any modifications therein as directed by the Engineer. All steel materials remaining after completion of the project, whether in the form of balance pieces or unutilised prime steel shall be returned to purchaser's stores by contractors) at his/their own cost as explained in sub-clause (iii) of clause 42 of conditions of contract and clause 18 of special Instructions to Tenders.

#### **6. DRAWINGS PREPARED BY ENGINEER**

**6.1** Checked and approved design drawings will be furnished to the contractor and all drawings so furnished shall form a part of the specification, Contractor shall consult these in detail for all information contained therein which pertains to and is required for his work.

**6.2** The Engineer reserve the right to make changes, revisions to drawings even after release for preparation of shop drawings are very likely to be made to reflect additional data/details received and more updated requirements. Revisions to drawings and any new drawings made to include additional work by contractor shall be considered a part of this specification and contract and the purchaser shall entertain no extra claims on this account.

**6.3** Unless otherwise specified, the drawings and specifications are intended to include everything obviously requisite and necessary for the proper and entire completion of the work and the job shall be carried out accordingly for the completeness as required.

**6.4** Design drawings prepared by the Engineer will show all the dimensions and if necessary connection of structure, loadings wherever necessary, size of each member, definite location of openings at various levels and all other information necessary to enable the contractor to prepare drawings for fabrication and erection.

**6.5** It shall be clearly understood that the Engineer's drawings are design drawings and are not intended to show connection details, thickness of members, cuts, notches bends and such other details.

**6.6** In the case of variations in drawings and specifications, the decision of the Engineer shall be final. Should contractor in the execution of his work, find discrepancies in the information furnished by the Engineer, he shall refer such discrepancies to the Engineer before proceeding with such work.

#### **7. DRAWINGS PREPARED BY CONTRACTOR**

**7.1** Contractor shall prepare all fabrication and erection drawings for the entire work. All the drawings shall be prepared in metric units. The drawings shall be of one standard size and the details shown therein shall be clear and legible. Some sample drawings on the lines of which contractor shall

prepare detailed fabrication drawings, are attached herein for the guidance of contractor. Drawings which do not meet the standard expected (refer typical sample drawings) will NOT BE ACCEPTED.

**7.2** Contractor should not commence shop detailing from information on the Engineer's design drawings unless such drawings or parts of such drawings are officially released with the stamp reading released for preparation of shop drawings. Contractor shall be responsible for the correctness of all shop drawings. Five prints each of contractor's drawings shall be submitted to the Engineer for scrutiny and approval and two prints to purchaser. The fabrication drawings shall be revised by contractor to reflect all revisions in design drawings as and when such revisions are made by the Engineer. The revised fabrication drawings shall be submitted to the Engineer for approval

**7.3** No detail shop drawings will be accepted for examination by the Engineer unless it is entirely complete, first completely checked and approved by contractor's qualified structural Engineer and accompanied by an erection plan showing the location of all pieces detailed. Contractor should check for reaction clearance and ensure that detailing of connections is carefully planned to obtain ease in erection of structures including field welded connections and bolting. Particular care is required when detailing joints with the use of High Strength Friction Grip Bolts as this involves clearances for use of sockets with torque wrenches.

**7.4** Fabrication shall not be started until Contractor has received copies of such drawings upon which the Engineer has endorsed his approval. Approval by the Engineer of any of the drawings shall not relieve the contractor from the responsibility for correctness of engineering, design of connections, workmanship, fit of parts, details, materials, errors or omissions of any and all work shown thereon. The Engineer's approval shall constitute approval of the size of members, dimensions, and general arrangement but shall not constitute approval of the connections between members and other details.

**7.5** Contractor shall submit design calculations for substitution/corrections/alteration and for the connection details approved by him.

**7.6** Each lot of drawings sent by the contractor for approval shall contain a limited number of drawings and shall be in an order and manner which follows erection sequence or as required by the Engineer/purchase based on priorities allocated.

**7.7** The Engineer will return one copy of contractor's drawings marked with his approval/comments. Contractor shall furnish purchaser with six prints and the Engineer with three prints of all approved final drawings for field use and record purpose. Contractor shall also furnish the purchaser as well as the Engineer with two direct reading reproducible of each drawing of quality not lesser than an 'Autopositive on extra thin paper capable of reproduction legible prints. These reproducible shall incorporate all modifications, field changes substitutions etc., effected and reflect the status "as built". It should be noted that so called 'Sepia' or similar process reproducible are not acceptable. All these reproducible shall be submitted rolled (not folded) on the outside of regular mailing tubes. All these drawings will remain the property of the purchaser. Purchaser reserve the right to use them in any manner whatsoever.

**7.8** The Drawings prepared by contractor and all subsequent revision etc. shall be at the cost of contractor for which no separate payment will be made. Revisions shall incorporate all modifications, field changes, substitutions etc. effected. The rates/prices quoted for fabrication work shall be deemed to include the cost of such drawing work also.

## **8. FABRICATION**

### **8.1 GENERAL**

All workmanship and finish shall be of the best quality and shall conform to the best approved method of fabrication. All materials shall be finished straight and shall be machined true and square

where so specified. All holes and edges shall be free of burrs. Shearing and chipping shall be neatly and accurately done and all portions of work exposed to view shall be nearly finished. Standard fabrication clearances as detailed in American Institute of Steel Construction Manuals shall generally be followed unless otherwise directed/approved. Material at the shops shall be kept clean and protected from weather.

## **8.2 CONNECTIONS**

**8.2.1** Shop connections shall be effected either by welding, riveting or high strength friction grip bolts as specified on the Engineer's design drawings. Either rivets, high strength grip bolts, welds or high tensile bolts shall be used for field connections as specified on the Engineer's design drawings.

**8.2.2** However standard M.S. bolts to IS : 1363 may be used for field connections for light members such as purlins, girts, staircase stringers, and landing beam, unless these bolts are permitted to be used by the Engineer for other connections also.

**8.2.3** High tensile bolts if used shall comply with the requirements of BS : 1083. R Quality or its equivalent in IS: 1367.

**8.2.4** Where necessary tapered washers or flat washers or spring washers shall be used with bolts. In case of high strength friction grip bolts hardened washers shall be used under the nuts or the heads depending upon whether the nuts or the heads are turned to tighten the bolts. The length of the bolts shall be such that at least one thread of the bolt projects beyond the nut except in case of high strength friction grip bolts where this/projection shall be at least three times the thread pitch.

**8.2.5** In all cases where bearing is critical, the unthreaded bolt shall bear on the members assembled. A washer of adequate thickness may be provided to exclude the threads from the bearing thickness. If a longer grip bolt has to be used for this purpose. All connections and splice shall be designed for full strength of members or loads indicated unless otherwise approved. Column splices shall be designed for the full tensile strength of the minimum cross section at the splice.

**8.2.6** Unless otherwise noted, beam and connections shall be designed for 60% of the shear capacity of the beam section plus additional axial forces, if any, shown on the Engineer's design drawings.

**8.2.7** All bolts, nuts washers, rivets, electrodes, screws etc. shall have supplied 10% in excess of the requirement

**8.2.8** All members likely to collect rain water shall have drain holes provided.

**8.2.9** Not more than one shop splice shall be provided to make up the full length of a member.

## **8.3 STRAIGHTENING**

Rolled material, before being worked, shall be straightened, unless otherwise required/specified. If straightening or flattening is necessary it shall be done by methods that will not injure the material. Long plates shall be straightened by passing through a angle or levelling rolls and structural shapes by the use of mechanical or hydraulic bar straightening machines. Heating or forging shall not be resorted to without the prior approval of the Engineer in writing.

## **8.4 CUTTING**

**8.4.1** Cutting may be by shearing, cropping, sawing or machine flame cutting. All reentrant corners shall be shaped notch-free to a radius of at least 12 mm. Sheared or cropped edges shall be dressed to a neat workmanlike finish and shall be free from distortion and burrs. The kerf/irregularities on machine flame cut edges shall be removed. Where machine flame cutting is permitted for high tensile steel, special care shall be taken to leave sufficient metal and all flame hardened material shall be removed by machining/edge planning.

**8.4.2** Hard flame cutting shall be undertaken only if so permitted by the Engineer and shall only be carried out by an expert in such work. Hand flame cut edges shall be ground smooth and straight.

**8.4.3** Edge planning of sheared, cropped or gas cut edges is not intended unless the sheared, cropped or gas cut edges are such as to warrant it or specifically called for.

## **8.5 ROLLING AND FORMING**

Plates for circular bins, bunkers etc. shall be accurately laid off and rolled or formed to required profile/shape as called for on the drawings. Adjacent sections shall be match-marked for facilitating accurate assembly, welding and erection in the field.

## **8.6 PUNCHING AND DRILLING**

**8.6.1** Holes in secondary members such as purlins, girts, lacing bars etc. may be punched full size through material not over 12 mm thick. Holes must be clean out without burr or ragged edges. Holes for all other connections shall be drilled accurately and the burrs removed effectively. Where several parts are to be connected to very close tolerances such parts shall be first assembled tightly clamped together and drilled through.

**8.6.2** Sub-punching may be permitted before assembly, provided the hole are punched 3 mm smaller in diameter than the required size and reamed after assembly to the full diameter. The thickness of material punched shall not exceed 16 mm.

**8.6.3** When batch drilling is carried out in one operation through two or more separable parts, these parts shall be separated after drilling and the burrs removed.

**8.6.4** Holes for turned and fitted bolts shall be drilled to a slightly smaller diameter and reamed to a diameter equal to the nominal diameter of the shank or barrel subject to H-8 tolerance specified in IS : 919.

**8.6.5** Where reamed members are taken apart for shipping or handling, the respective pieces reamed together shall be so marked that they may be reassembled in the same position in the final setting up. No interchange of reamed parts will be permitted. Poor matching, over drilling and volatility in holes shall be a cause for rejection. Burning holes with gas is strictly prohibited.

## **8.7 RIVETTING: DELETED.**

## **8.8 HIGH STRENGTH FRICTION GRIP BOLTING: DELETED.**

## **8.9 WELDING:**

**8.9.1** Electrodes for shielded arc manual welds shall comply with the requirements of IS: 814 and/or BS: 634 and/or AWS A-5.1 and shall be of an approved make.

**8.9.2** The electrodes shall be suitable for use in the position and type of work as laid down in the above specifications and as recommended by the manufacturer. Electrodes of classification AWS E 60 XX shall be used and IS : 2062 and of classification AWS E 70 XX for steel conforming to IS : 226 and IS: 2062 and of classification AWS E 70 XX for steel conforming to IS : 961. Joints in materials above 20 mm thick and all important connections shall be made with low hydrogen electrodes of AWS E 7016 or E 7018 classification.

**8.9.3** The filler wire and flux combination for submerged arc welding shall conform to the requirements for the desired applications as laid down in IS: 3613. The weld metal deposited by the submerged arc process shall have mechanical properties not less than that specified for American

welding society's classification 5.17 F 60 for steel to IS: 226 and IS: 2062 and AWS classification 5.17 F 70 for steel to IS : 961.

**8.9.4** Electrodes flux covering shall be sound and unbroken. Broken or damaged coating shall cause the electrodes to be discarded. Covered electrodes for manual arc welding shall be properly stored in an oven prior to use in a manner recommended by the manufacturer and only an hour's quota shall be issued to each welder from the oven.

**8.9.5** Electrodes larger than 5 mm diameter shall not be used for root-runs in butt welds.

**8.9.6** Welding plant and accessories shall have capacity adequate for the welding procedure laid down and shall satisfy appropriate standards and be of approved make and quality. Contractor shall maintain all welding plant in good working order. All the electrical plants in connection with the welding operation shall be properly and adequately earthed and adequate means of measuring the current shall be provided.

**8.9.7** All welds shall be made only by welders and welding operators who have been properly trained and previously qualified by tests to perform the type of work required as prescribed in the relevant applicable standards.

**8.9.8** All welds shall be free from defects like blow holes, slag inclusion, lack of penetration, undercutting, cracks etc. All welds shall be cleaned of slag or flux and show uniform sections, smoothness of weld metal. feather edges without overlap and freedom from porosity.

**8.9.9** Fusion faces and surfaces adjacent to the joint for a distance of at least 50 mm on either side shall be absolutely free from grease, paint, loose scales, moisture or any other substance which might interfere with welding or adversely affect the quality of the weld. Joint surfaces shall be smooth, uniform and free from fins, tears, laminations etc. Preparation of fusion faces shall be done in accordance with the approved fabrication drawings by faces shall be done in accordance with the approved fabrication drawings by shearing, chipping, machining or machine flame cutting except that shearing shall not be used for thickness over 8 mm. weld.

**8.9.10** In the fabrication of cover plated beams and built up members all shop splices in each component part shall be made before such component part is welded to other parts of the member. Wherever weld reinforcement interferes with proper fit-up between components to be assembled for welding, these welds shall be ground flush prior to assembly.

**8.9.11** The members to be joined by fillet welding shall be brought and held as close together as possible and in no event shall be separated by more than 3 mm. If the separation is 1.5 mm or greater the fillet weld size shall be increased by the amount of separation. This shall only apply if the surfaces are completely sealed by welds. In all other cases the fit-up shall be close enough to exclude water after painting.

**8.9.12** The separation between faying surfaces of lap joints and butt joints with backing plate shall not exceed 1.5 mm. Abutting parts to be butt welded shall be carefully aligned and the correct root gap maintained throughout the welding operation. Misalignment greater than 25 percent of the thickness of the thinner plate or 3 mm whichever is smaller shall be corrected and in making the correction the parts shall not be drawn into a slope sharper than 2 degrees (1 in 27.5).

**8.9.13** Prequalified welding procedures recommended by appropriate welding standards and known to provide satisfactory welds shall be followed. For non-standard procedures, qualification tests as prescribed in IS : 823 shall be made to verify the adequacy of the procedures. A welding procedure shall be prepared by contractor and submitted to the Engineer for approval before start of welding. This shall include all details of welding procedure with reference to provisions of IS : 823 and IS : 4353. Approval of the welding procedure by the Engineer shall not relieve contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.

**8.9.14** Submerged arc, automatic or semi-automatic welding shall generally be employed. Only where it is not practicable to use submerged arc welding, manual arc welding, may be resorted to.

**8.9.15** Voltage and current (and polarity if direct current is used) shall be set according to the recommendations of the manufacturer of the electrode being used and suitability to thickness of material, joint form etc.

**8.9.16** The work shall be positioned for flat welding wherever practicable and over head weld shall be avoided.

**8.9.17** No welding shall be done when surface of the member is wet nor during periods of high wind unless the welding operator and the work arc protected.

**8.9.18** IN joints connected by fillet welds, the minimum size of single run fillet welds are first runs and minimum full sizes of fillet welds shall conform to the requirements of IS : 816 and IS : 823

**8.9.19** Fillet welds larger than 8 mm shall be made with 2 or more passes.

**8.9.20** All Complete penetration butt welds made by manual arc welding except, when produced with the aid of backing material or welded in flat position, from both side in square - edge material not over 8 mm thick with root opening not less than one half the thickness of the thinner part joint, shall have the root of the initial layer gauged out on the bake side before welding is started from that side, and shall be welded as to secure sound matter and complete fusion through out the entire cross section.

**8.9.21** Butt welds shall be terminated at the ends of joint in a manner that will ensure their soundness. Where abutting parts are 20 mm or more in thickness run-on and run-off plates with similar edge preparation and having a width not less than the thickness of the thicker part joined shall be used. These extension pieces shall be removed upon completion of the weld and the ends of the weld make smooth and flush with the abutting parts. Where the abutting part are thinner than 20 mm, the extension pieces may be omitted but the ends of the butt welds shall than be chipped or gauged out to sound metal and side. welded of fill up the ends to the required reinforcement.

**8.9.22** Each layer of a multiple layer weld except root and surface runs may be moderately peened with light blows from a blunt tool. Care shall be exercised to prevent scaling or flaking of weld and base metal from overpeening.

**8.9.23** No welding shall be done on base metal at a temperature below 50°C Base metal shall be preheated as required to the temperature given in the table below prior to tack welding or welding. When base metal not otherwise required to be preheated is at a temperature below 0°C, it shall be preheated to at least 20° C prior to tack welding or welding. Preheating shall bring the surface of the base metal within 75 mm of the point of welding to the specified preheat temperature, and this temperatures shall be maintained as minimum interpass temperature while welding is in progress.

Thickness of thickest part at point of welding	Minimum preheat and interpass temperature in degree centigrade			
	Other than low-hydrogen welding electrodes		Low hydrogen welding electrodes	
	IS : 226 Steel or IS : 2061 Steel	IS : 961 steel	IS : 226 Steel or IS : 2061 Steel	IS : 961 steel
Upto 20 mm incl.	None	Welding with this process not allowed	None	10
Over 20 mm to 40 mm incl.	65		10	65
Over 40 mm to 63 mm incl.	110		95	110
Over 63 mm	150		110	65

Minimum preheat for IS: 226 steel in thickness up to 80 mm shall be 10°C.

**8.9.24** Electrodes other than low hydrogen electrodes shall not be permitted for thicknesses of 75 mm and above.

**8.9.25** Before commencing fabrication of a member or structure in which weldings is likely to result in distortion and/or locked up stresses a complete programme of fabrication assembly and welding shall be made and submitted to the Engineer for approval. Such a programme shall include, besides other appropriate details, full particulars in regard to the following.

- i) Proposed prebending in components such as flanges and presetting of joints to offset expected distortion.
- ii) Make up of subassemblies proposed to be welded before incorporation in final assembly.
- iii) Proposed joint forms, classification of wire and flux or covered electrodes, welding process including fitting and welding sequence with directions in which freedom of movement is to be allowed.
- iv) Proposed number, spacing and type of strong backs and details of jigs and fixtures for maintaining proper fit-up and alignment during welding.
- v) Any other special features like assembling similar members back to back or stress relied. If so desired by the Engineer, mock up welding shall be carried out at contractor's cost to establish the efficacy of the proposed programme, with any modification suggested by the Engineer, in limiting distortion or/and residual stress to acceptable levels.

**8.9.26** Inspection of welds: All welds shall be inspected for flaws by any of the methods described under clause 10 "Inspection". The choice of the method adopted shall be determined by purchaser/Engineer.

**8.9.27** Contractor shall quote separately for carrying out such tests as called for in the schedule of quantities. Contractor shall be paid only for test which establish soundness of welds. In case the tests uncover defective work such tests will be at contractor's cost and contractor shall correct such defects at his own cost and prove the soundness of rectified work.

**8.9.28** The correction of defective welds shall be carried out as directed by the Engineer without damaging the parent metal. When a crack in the weld is removed, magnetic particle inspection or any other equally positive means as prescribed by the Engineer shall be used to ensure that the whole of the crack and material upto 25 mm beyond each end of the crack has been removed. Cost of all such tests and operations incidental to correction shall be to contractor's account.

## **8.10 TOLERANCE**

The dimensional and weight tolerances for rolled shapes shall be in accordance with IS : 1852 and/or ASTM A6.

No rolled or fabricated member shall deviate from straightens by more than 1/1000 of the axial length or 10 mm whichever is smaller.'

The length of members with both ends finished for contract shall have a tolerance off 1 mm.

Members without ends finished for contract bearing shall have a tolerance of +1.5 mm for members upto 10 meters long and a tolerance of + 3 mm for members over 10 meter in length.

Lateral deviation between centre line of web plate and centreline of flange plate at contact surface, in the case of built up sections shall not exceed 3 mm.

The combined warpage and tilt of flanges in welded built up section shall not exceed 1/200th of the flange width or 3 mm whichever is smaller.

The deviation from flatness of welded plate girder weld in the length between stiffeners or a length equal to the depth of the girder shall not exceed 1/150th of such length.

Deviations from the specified depth of welded girders measured at the centre line of the web shall not exceed  $\pm 3$  mm upto a depth of 1000 mm, +5 for depths above 1000 mm upto 2000 mm and +8 mm and -5 mm for depth over 2000 mm.

## **8.11 END MILLING**

Column ends bearing on each other or resting on base plates and compression joints designed for bearing shall be milled true and square to ensure proper bearing and alignment. Base plates shall have their surfaces milled true and square.

## **9. INSPECTION**

**9.1** Contractor shall give due notice to the Engineer/Purchaser in advance of the materials or workmanship getting ready for inspection. All rejected materials shall be promptly removed from the shop and replaced with new material for the Engineer's/Purchaser's approval/inspection. The fact that certain material has been accepted at contractor's shop shall not invalidate final rejection at site by Purchaser/Engineer if it fails to be in proper condition or has fabrication inaccuracies which prevents proper assembly. No materials shall be painted or despatched to site without the inspection and approval by Purchaser/Engineer unless such inspection is waived in writing by the Engineer.

Shop Inspection by the Engineer or his authorised representative on submission of test certificates and acceptance thereof by the Engineer shall not relieve contractor from the responsibility of furnishing material conforming to the requirements of these specifications, nor shall it invalidate any claim which the purchaser may make because of defective or unsatisfactory material and of workmanship.

Contractor shall provide all the testing and inspection service and facilities for shop work except where otherwise specified. Contractor's inspection work shall be under the control of a competent chief inspector whose primary responsibility is inspection reporting to management and not to production departments.

For fabrication work carried out in the field the same standard of supervision and quality control shall be maintained as in shop fabricated work. The inspection and testing shall be conducted in a manner satisfactory to the Engineer.

**9.2** The inspection and tests on structural steel members shall be as set forth below.

**9.2.1** Material testing:

If mill test reports are not available for any steel materials, the same shall be got tested by contractor to the Engineer satisfaction to demonstrate conformity with the relevant specification.

## **9.3 TESTS ON WELDS:**

The undernutrition tests are not generally required for the work and if required will be paid extra.

**9.3.1** Magnetic Particle Test:

Where root and intermediate passes of weld is examined by magnetic particle testing, such testing shall be carried out throughout the entire length in accordance with ASTM specification E - 109. In the case of completed welds, such tests shall be carried out in accordance with ASTM specification



E 109, or E-138 as decided by the Engineer. If heat treatment is performed, the completed weld shall be examined after the heat treatment. All defects shall be repaired and retested. Magnetic particle tests shall be carried out using alternating current. Direct current may be used with the permission of the Engineer.

### **9.3.2 Liquid Penetrant Inspection:**

In the case of welds examined by liquid Penetrant Inspection, such tests shall be carried out in accordance with ASTM E - 165 or IS: 3658. All defects shown shall be repaired and rechecked.

### **9.3.3 Radiographic Inspection**

All full strength butt welds shall be fully radiographed in accordance with the recommended practice for radiographic testing as per ASTM E 94 and part U.W. 51 of ASTM code Section VIII.

## **9.4 DIMENSIONS, WORKMANSHIP AND CLEANLINESS**

The Structural steel members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment and surface finish, painting where specified are in accordance with requirements shown on Contractor's approved shop drawings and Engineer's drawings.

## **9.5 INSPECTION OF TEST FAILURE**

In the event of any failure of structural steel members to meet an inspection or test requirement, contractor shall notify Engineer or his authorised representative. Contractor must obtain permission from Engineer before repair is undertaken. The quality control procedures to be followed to ensure satisfactory repair shall be subject to approval by Engineer.

**9.6** Engineer has a right to specify additional inspection, testing as he deems necessary and the additional cost of such testing will be borne by Purchaser.

Contractor shall maintain records of all inspection and testing which shall be made available to Engineer or his authorised representative.

## **10. SHOP MATCHING**

Some steel work, particularly columns along with the tie beams/bracing may have to be shop assembled to ensure satisfactory fabrication, obtaining of adequate bearing areas etc. If so desired by Engineer at no extra cost to Purchaser.

## **11. DRILLING HOLES FOR OTHER WORKS**

Holes in members required for installing equipment or steel furnished by other manufacturers or other contractors shall be drilled in contractor's shop as part of this contract, the information for which will be supplied by Purchaser/Engineer before fabrications of the steel.

## **12. ERECTION OF STRUCTURAL STEEL**

12.1 This specification covers requirements for erection of structural and miscellaneous steel.

### **12.2 ERECTION SCHEME**

Each bid shall be accompanied by a broad erection scheme prepared by the Bidder after a thorough study of the bid drawings and the site conditions. This erection scheme shall describe the methods proposed to be employed by the contractor for unloading, transporting within the site, handling, assembling, hoisting and erection of the structural and miscellaneous steel components and

the type, capacity and quantity of equipment that the contractor proposes to bring to site for all these operations. The scheme shall also indicate the strength and trade-wise compositions of the work force and supervisory personnel that will be deployed by the contractor for the various operations.

### **12.3 ELECTION PROGRAMME**

**12.3.1** The successful bidder shall submit, within six weeks of the acceptance of his bid, a detailed reaction programme, in consultation with the fabricator where fabrication of structural and miscellaneous steel is being done by another agency. This programme shall be accompanied by a layout plan identifying the areas proposed for unloading, main storage, subsidiary storage, assembly and the transportation of equipment and fabricated materials between the storage and work areas. The layout shall clearly indicate the points at which proposed erection begins, the directions in which it is proposed to progress, the deployment of equipments, access route to cranes to reach work areas etc. The locations and extent of site offices and stores, labour quarters if any, layout of electrical cables and water pipes from the tap off points indicated on drawings shall also be indicated in detail on the above layout. Full details of the method of handling, hoisting and erection including false work, staging, temporary bracing, guying etc. shall be furnished by the contractor in this erection programme along with completed details of the quantity and capacity of the various items of erection equipment that will be used. A site organization chart showing the number of supervisory personnel, the number and composition of the various gangs shall also accompany the erection programme.

**12.3.2** Any modifications to the erection programme directed by Engineer for the reasons of inadequacy of the quantity and/or capacity of the erection equipment, temporary bracing, guying etc. or safety of the erection methods, or stability of the erection sequence due to interference with the work of other shall be incorporated by contractor and the work shall be carried out in accordance with the revised programme. The approval by Engineer shall not relieve contractor from his responsibility for the safe, sound, accurate and timely erection of structural steel work as required by Engineer. Contractor shall also make no extra claims for bringing additional equipment while bidding for the work and no additional compensation shall be claimed on this account.

### **12.4 SITE OPERATIONS**

**12.4.1** An experienced and qualified Engineer/Foreman shall be in full time charge of the job.

**12.4.2** Contractor shall complete all preliminary works at site well before the arrival of structural steel, such as establishment of office, stores, unloading gantry, labour quarters if any, electrical and water connections, electrical winches, derricks, cranes, compressors, all tools and tackle, rivet guns, welding sets, torque wrenches, spud wrenches, staging etc., as part of his contract and any other work that may be necessary so as to start erection immediately after the arrival of first batch of steel at site.

**12.4.3** Contractor shall furnish at his own expenses, the necessary nonflammable staging and hoisting materials or equipment required for the erection work and shall remove and take them away after completion of the job. Contractor shall also provide necessary passage ways, fences, safety belts, helmets, lights and other fittings to the satisfaction of Owner/Engineer and meet the rules of local authorities and for protection to his men and materials. A licensed electrician shall be kept on the job for full period to maintain contractor's electrical equipment and connection.

**12.4.4** Contractor shall protect all existing plant structures, piping, conduits, equipments and facilities against damage during erection. Any damage caused by contractor shall be rectified entirely at contractor's cost to the satisfaction of Owner/Engineer. If work has to be carried out adjacent to existing switchyards or electrical installations which are live, contractor must ensure suitable safety precautions in consultation with Engineer.

**12.4.5** If a portion of the work or project areas cannot be made available to contractor for his activities due to operations being carried out by other agencies he shall suitably modify his sequence of operations, so as to continue work without interruption. Contractor shall work in coordination with other

agencies working on the project site and plan his work suitably so as not to hinder the progress of construction at site.

## **12.5 HANDLING AND STORAGE**

No dragging of steel shall be permitted. All steel shall be stored 300 mm above ground on suitable packing to avoid damage, in the order required for erection, and with erection marks visible. All storage areas shall be prepared and maintained by contractor. Steel shall not be stored in the vicinity of areas where excavation or grading will be done and if stored temporarily, this shall be removed by contractor well before such excavation and/or grading commence to a safe distance to avoid burial under debris.

Scratched or abraded steel shall be given a coat of the primer specified on drawings for protection after unloading and handling prior to erection. All milled and machined surfaces shall be properly protected from rust/corrosion by suitable coating and also from getting damaged.

## **12.6 ANCHOR BOLTS AND FOUNDATIONS**

**12.6.1** Contractor shall carefully check the location and layout of anchor bolts embedded or foundations constructed to ensure that the structures can be properly erected as shown on the drawing. Any discrepancy in the anchor bolts/foundations shall be reported to Engineer.

Anchor bolts may be provided with three nuts on upper threaded portion. One of which may be used for levelling the column base to the required elevation and one will be a lock nut. All shim stock required for erection shall be of good M.S. plates and shall be supplied by contractor at his cost.

**12.6.2** A certain amount of cleaning of foundations and preparing the area is considered normal and shall be carried out by contractor at no extra cost.

**12.6.3** Where beams bear in pockets or on walls, bearing plates shall be set and levelled as part of the work. All grouting under column base plates will be carried out by the contractor as specified on drawings.

## **12.7 ASSEMBLY AND CONNECTIONS**

**12.7.1** Field connection may be effected either by riveting, bolting, welding or by use of high strength friction grip bolts as specified under section - A and as shown on the design and erection drawings.

All welding shall be in accordance with IS : 816 - Code of Practice for use of metal arc welding for general construction in mild steel and IS : 823 - Code of Procedure for Manual Arc Welding of Mild Steel.

Riveting and high strength friction grip bolting shall be as stipulated in the drawing. All assembling shall be carried on a level platform.

**12.7.2** Drafts shall be used only for drawing the work to proper position and must not be used to such an extent as to damage the holes. Size of drifts, larger than the nominal diameter of hole shall be used. Any damaged holes or burrs must be rectified to the satisfaction of the Engineer.

**12.7.3** Corrections of minor misfits and reasonable amount of reaming cutting of excess stock from rivet shall be considered as a part of erection. Any error in shop which prevents proper fit on a moderate amount of reaming and slight chipping or cutting shall be immediately report to Engineer.

## **12.8 ERECTION**

**12.8.1** All structural steel shall be erected as shown on the drawings. Proper size steel cable slings, etc. shall be used for hoisting. Guys shall not be anchored to existing structures, foundations etc. unless so permitted by Engineer in writing.

**12.8.2** Steel columns in the basement, if any, are to be lowered and erected carefully with the help of a crane and/or derrick without damaging the basement walls or floor.

**12.8.3** Structural steel frames shall be erected plumb and true. All steel columns and beams shall be checked for plumb and level individually before and after connections are made. Temporary bracing shall be introduced wherever necessary to take care of all loads to which the structure may be subjected including erection equipment and the operation thereof. Such bracing shall be left in place as long as may be required for safety and stability.

**12.8.4** As erection progresses, the work shall be securely bolted to take care of all dead load, wind seismic and erection stresses.

**12.8.5** No riveting or welding or final bolting shall be done until the structure has been properly aligned and approved by Engineer. No cutting, heating or enlarging of the holes shall be carried out without the prior approval of Engineer.

**12.8.6** After steel has been erected all bare and abraded spots, rivet heads, field welds, bolt heads and nuts shall be spot painted with primer specified on drawings. Before paint is applied, the surface shall be dry and free from dust, dirt, scale and grease. All surfaces inaccessible after erection shall receive two coats of the approved paint before erection.

## **12.9 INSPECTION**

Engineer/Purchaser or their authorised representatives shall have free access to all parts of the job during and all erection shall be subject to their approval. In case of faulty erection all such dismantling and re-erection required will be at contractor's cost. No paint shall be applied to rivet heads or field welds or bolts until these have been approved by Engineer.

## **12.10 TOLERANCES**

The shift of column axis at column base from the marked axis shall not exceed 5 mm. All column tiers shall be plumb within a tolerance of 1 in 500 and the structures as a whole plumb within a tolerance of 1 in 1000. In no case, however, shall the displacement from/plumb of column tiers exceed 10 mm and the total displacement of the structure as a whole exceed 25 mm for structures upto 50 meters and an additional displacement of 1 mm for every 2.5 meters additional height subject to a maximum displacement of 50 mm. The actual levels of supports of trusses, collar beams, roofing beams, purlins, etc. shall not vary by more than 20 mm from their marked levels. The sweep of trusses, beams, etc. in the horizontal plane shall not exceed 1/1500 of their span subject to a maximum of 10 mm. Further the deviation of the upper chords of trusses from vertical plane through centres of supports shall be within 1/250th of the truss height. Deviation in spacing of purlins shall be within 5 mm. unless otherwise specified on drawing the deviations in crane rail alignment shall be within the following permissible tolerances.

Vertical	±	2 mm
Horizontal	±	2 mm
Gauge variation	±	0.2 mm

## **13. PAINTING**

**13.1** All fabricated steel material except those galvanised shall receive protective paint coating as specified on design drawings.

**13.2** The surface of steel work to be painted shall be thoroughly cleaned of all loose mill scale, rust, grease, dirt and other foreign matter by hand tool cleaning, power tool cleaning, flame cleaning or sand

shot blasting as indicated on drawings. In power brushing sufficient care shall be exercised not to furnish mill scale to a slick finish to which paint may not adhere properly.

**13.3** The paint treatment specified on drawings, shall be applied either by brushing or spraying on the thoroughly cleaned and dry surface. Airless spraying shall be done if so specified.

Surface inaccessible after assembly shall receive an additional cost of the specified paint prior to assembly.

**13.4** Paint shall be stirred frequently to keep the pigment in suspension. All paint delivered to the fabrication shop shall be ready mixed in original sealed containers as packed by the paint manufacturer and no thinner shall be permitted. No painting shall be done in frosty/foggy weather or when the humidity is high enough to cause condensation on the surface to be painted. Paint shall not be applied when the temperature of the surface to be painted is 5 degree centigrade or lower.

#### **14. METHOD OF MEASUREMENTS**

**14.1** For the purpose of payment, the weight of the actual, completed structures shall be calculated from the approved drawings for different items of work.

**14.2** Full weight of rivets and bolts shall be taken into account in calculating the weight of the completed structure. No allowance will be permitted for galvanizing, welding or for rolling margins. One tonne for the purpose of payment shall mean ONE METRIC TONNE i.e. 1000 KG.

**14.3** The weight of member made out of standard rolled section such as beam, channels, angles etc. shall be based on the standard IS book, weight of member, without deducting for holes, notches, bevels, cuts etc. Where a component consists of a cut joist or channel the full half the depth of the section is used. Otherwise only half the section unit weight shall be considered for calculation of the weight of the component. Deductions shall be made from the weight of plates for skew cuts and notches of 900 sq.mm. or larger.

The weight of any built-up member shall be separated into weight of each component.

# **PART -C:**

## **SPECIFICATION FOR PLAIN, REINFORCED AND PRECAST CONCRETE AND ALLIED WORKS**

### **1. SCOPE**

This specification covers the general Requirements for mixing and placing of plain, reinforced and precast to be used on jobs on site production facilities including requirements in regards to the quality, handling, storage of ingredients, design of concrete mix. proportioning, sampling, batching, mixing and testing of concrete formwork, construction joints and also requirements in regard to the quality, storage, bending and fixing of reinforcements. This also covers the transportation of concrete from the mixer to the place of final deposit and the placing, curing, protecting, grouting, repairing and finishing of concrete, inspection, clean up and other miscellaneous works. All information pertaining to plain, reinforced and precast concrete shown and noted on the drawing shall be considered part of this specification and shall supersede these specifications where information thereon in contrary to the contents of these specifications.

### **2.0 APPLICABLE CODES AND SPECIFICATIONS**

The following specifications, standards and codes are made a part of this specifications. All standards tentative specifications, codes of practices, referred to herein shall be the latest edition including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specifications shall govern.

### **2.1 MATERIALS:**

1. IS : 269 - Specification for ordinary, rapid hardening and low heat portland cement.
- IS : 8112 - Specification for ordinary portland cement grade - 43
- IS : 12269 - Specification for ordinary portland cement grade - 53
2. IS : 303 - Plywood for general purpose.
3. IS : 455 - Specification for portland blast furnace slag cement.
4. IS : 515 - Specification for metal and manufactured aggregates for use in mass concrete.
5. IS : 1489 - Specification for portland pozzolana cement.
6. IS : 4031 - Methods of physical tests for hydraulic cement.
7. IS : 650 - Specification for standard sand for testing of cement.
8. IS : 383 - Specification for coarse and fine aggregates from natural sources for concrete.
9. IS : 2386 - Methods of test for aggregates for concrete.
- (Parts I to VIII)
10. I.S.: 516 - Methods of test for strength of concrete.

- 11. I.S. :1199 - Methods of sampling and analysis of concrete.
- 12. I.S.: 3025 - Methods of sampling and test (Physical and Chemical) water used in industry.

## **2.2 EQUIPMENTS**

- 13. IS : 1629 - Rules for grading of cut sizes of timber.
- 14. IS : 432 - Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.  
(Part I & II)
- 15. IS : 1139 - Specification for hot rolled mild steel and medium tensile steel deformed bars.
- 16. IS : 1566 - Specification for plain hard drawn steel wire fabric for concrete reinforcement.
- 17. IS : 1785 - Specification for plain hard drawn steel wire for prestressed concrete.
- 18. IS : 1786 - Specification for cold twisted steel bars for concrete reinforcement.
- 19. IS : 2090 - Specification for high tensile steel bars used in prestressed concrete.
- 20. IS : 4990 - Specification for plywood for concrete shuttering work.
- 21. IS : 2645 - Specification for integral cement waterproofing compounds.

## **2.2 EQUIPMENTS**

- 1. IS : 1791 - Specification for batch type concrete mixers.
- 2. IS : 2438 - Specification for roller pan mixer.
- 3. IS : 2502 - Specification for concrete vibrators, immersion type.
- 4. IS : 2506 - Specification for screed board concrete vibrators.
- 5. IS : 2514 - Specification for concrete vibrating tables.
- 6. IS : 3336 - Specification for pan vibrators.
- 7. IS : 4656 - Specification for form vibrators for concrete.
- 8. IS : 2722 - Specification for portable swing weigh batchers for concrete (Single and double bucket type)
- 9. IS : 2750 - Specification for steel scaffoldings.

## **2.3 CODES OF PRACTICE**

- 1. I.S.: 456 - Code of practice for plain and reinforced concrete.
- 2. I.S. : 1343 - Code of practice for prestressed concrete.

3. I.S. : 457 - Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
4. I.S.: 3370 - Code of practice for concrete structures for storage of liquids. (Part I to IV)
5. I.S.: 3935 - Code of practice for concrete structures for storage of liquids. (Part I to IV)
6. I.S.: 3201 - Criteria for design and construction of precast concrete trusses.
7. I.S.: 2204 - Code of practice for construction of reinforced concrete shell roof.
8. I.S.: 2210 - Criteria for the design of R.C. shell, structures and folded plats.
9. I.S.: 2751 - Code of practice for welding of mild steel bars used for reinforced concrete construction.
10. I.S.: 2502 - Code of practice for bending and fixing of bars for concrete reinforcement.
11. I.S.: 3558 - Code of practice for use of immersion vibrators for consolidating concrete.
12. I.S. : 3414 - Code of practice for design and installation of joints in buildings.
13. I.S. : 4014 - Code of practice for steel tabular scaffolding.  
(Part I & II)
14. I.S. : 2571 - Code of practice for laying insight cement concrete flooring.

## **2.4 CONSTRUCTION SAFETY**

1. I.S. 3696 - Safety code for scaffolds and ladders.  
(Part I & II)

## **2.5 MEASUREMENT**

1. I.S. : 1200 - Methods of measurement of building works.
2. I.S.: 3385 - Code of practice for measurement of civil engineering works.

**2.6** In the event that state, city or other government bodies have requirements more stringent than those set forth in this specification, such requirements shall be considered part of this specification and shall supercede this specification where applicable.

## **3.0 GENERAL**

**3.1** The quality of materials and method and control of manufacture and transportation of all concrete work irrespective of mix. whether reinforced or otherwise, shall conform to the applicable portion of this specification.

**3.2** The Engineer shall have the right to inspect the source/s of material/s, the layout and operation of procurement and storage of materials, the concrete batching and mixing equipment, and the quality control system, such an inspection shall be arranged and the Engineer's approval obtained, prior to starting of concrete work.



**3.3** All materials shall be procured only from approved sources. Such approvals will be given by the Engineer only after tests have been made to ensure that all materials are as per this specifications and that concrete of acceptable quality can be made from the materials procured. The Engineer however, reserves the right to reject the materials and also disapprove the source even without conducting any; tests on materials, if he, in his judgement, considers that the materials are unsuitable.

**3.4** Every facility shall be provided to the Engineer for sampling, inspection and testing at the source and at the site of work.

**3.5** Samples of materials, proposed to be used shall be submitted free of cost in sufficient quantity to the Engineer for his approval. Approved samples shall be preserved by the Engineer for future reference. This approval shall not, in any way, relieve the contractor of his responsibility for ensuring supply of materials, instruct conformity to the specifications.

**3.6** All materials considered damaged, deteriorated or not conforming to the specifications or considered defective shall be immediately removed from the site of work. If the contractor fails to remove the materials within 48 hours of the notice given by the Engineer, the Engineer reserve the right to have the materials removed from the site at Contractor's cost.

**3.7** All the materials shall be so stored as to prevent deterioration or contamination by foreign matters and to ensure the preservation of their quality and fitness for the work. If the storage arrangement is not the Engineer's satisfaction, the Engineer may; direct the contractor to make such arrangement as he considers necessary and in the event of non compliance, he would reserve the right to make proper arrangements through other agency at the contractor's cost. All materials shall be stored in adequate quantities well in advance to meet the construction schedule.

#### **4.0 MATERIALS FOR STANDARD CONCRETE**

The ingredients to be used in the manufacture of standard concrete shall consist solely of a standard type portland cement, clean sand, natural coarse aggregate, clean water and admixtures, if specially called for on drawings or specifications.

#### **4.1 CEMENT**

**4.1.1** Unless otherwise specified or called for by the Engineer/Owner, cement shall be of any of the following in 50 kg bags and the type selected should be appropriate for the intended use and as per the contract conditions specifications and drawings.

- a) 33 Grade Ordinary Portland cement conforming to IS 269
- b) 43 Grade ordinary Portland cement conforming to IS 8112
- c) 53 Grade ordinary Portland Cement conforming to IS 12269
- d) Portland slag cement conforming to IS 455.
- e) Portland pozzolana cement (fly ash based ) conforming to IS 1489 (Part I)
- f) *Portland pozzolona cement (calcined clay based* conforming to IS 1489 (Part 2)
- g) Sulphate resisting Portland cement conforming to IS 12330.

In case the job requires specific use of any of the following cements the same shall be used with the prior approval of the EIC and necessary precautions with regard to their setting and hardening time, time required for de-shuttering, curing etc., shall be taken after carefully complying with specific literature with regard to those types.

- 1.High Alumina cement - conforming to IS 6452
- 2.Low heat cement - conforming to IS 12600
- 3.Super sulphate cement - conforming to IS 6909
- 4.Rapid Hardening cement - conforming to IS 8041
- 5. Blended Cement for finishing work as below

Other combinations of Portland Cement with mineral admixtures of quality conforming to

relevant Indian Standards laid down may also be used in the manufacture of concrete provided that there are satisfactory data on their suitability, such as performance test on concrete containing them and only in such case where in specifically called for in the contract.

#### **Mineral Admixtures**

**Pozzolana:** Pozzolanic materials conforming to relevant Indian Standards may be used with the permission of Engineer-in-charge, provided uniform blending with cement is ensured.

**Fly ash (pulverized fuel ash):** Fly ash conforming to Grade 1 of IS 3812 may be used as part replacement of ordinary Portland cement provided uniform blending with cement is ensured.

**Silica fume:** Silica fume conforming to a standard approved by the deciding authority can be used as part replacement of cement provided uniform blending with the cement is ensured.

**Note:** The silica fume (very fine non –crystalline silicon dioxide) is a by-product of the manufacture of silicon, ferrosilicon or the like, from quartz and carbon in electric arc furnace. It is usually used in proportion of 5 to 10 percent of the cement content of a mix.

**Rice husk ash:** Rice husk ash giving required performance and uniformity characteristics may be used with the approval of the deciding authority.

**Note:** Rice husk ash is produced by burning rice husk and contain large proportion of silica. To achieve amorphous state, rice husk may be burnt at controlled temperature. It is necessary to evaluate the product from a particular source for performance and uniformity since it can range from being as deleterious as silt when incorporated in concrete. Water demand and drying shrinkage should be studied before using rice husk.

**Metakaoline:** Metakaoline having fineness between 700 to 900m<sup>2</sup>/kg may be used as pozzolanic material in concrete.

**Note:** Metakaoline is obtained by calcination of pure or refined kaolintic clay at a temperature between 650 0C and 8500C, followed by grinding to achieve a fineness of 700 to 900 m<sup>2</sup>/kg. The resulting material has high pozzolanicity.

**4.1.2** A certified report attesting to the conformance of the cement to I.S. specifications by the cement manufactures chemist shall be furnished to Engineer, if demanded. Random tests on cement brought by contractor shall be performed by the Engineer. The cost to be incurred on these tests in client's laboratory or other approved laboratory shall be entirely born by the contractor. In the event of rejection, contractor shall promptly .remove the cement from site and no claim on this account shall be entertained.

**4.1.3** Contractor will have to make his own arrangements for the storage of adequate quantity of cement. If supplies are arranged by; Owner, cement will be issued in quantities to cover work requirements of one month or more, as deemed fit by the Engineer and it will be the responsibility of the contractor to ensure adequate and proper storage. Cement in bulk may be stored in bins or silos which will provide complete protection from dampness, contamination and minimize caking and false set. Cement bags shall be stored in a dry enclosed shed (storage under tarpaulins will not be permitted, well away from the outer walls and insulated from the floor to avoid contact with mixture from ground and so arranged as to provide ready access. Damaged or reclaimed or partly set cement will not,be permitted to be used and shall be removed from the site. The storage bins and storage arrangements shall be such that there is no dead storage. Each consignment shall be stacked separately with the date of receipt flagged on. Not more than 12 bags shall be stacked in height. The bags being arranged with headers and stretchers. The storage arrangement shall be as per I.S. 4082 and as approved by the Engineer. Consignments of cement shall be stored as received and shall be consumed in the order of their delivery.

**4.1.4** Cement held in storage for a period of ninety (90) days or longer shall not be permitted for concreting work. Should at any time, the Engineer have reasons to consider that any cement is defective, irrespective of its origin and / or manufacturer's test certificate, such cement shall be tested immediately, at a National Test Laboratory / approved laboratory, and until receipt of satisfactory test report, cement shall not be used in any work. The contractor shall keep accurate reports of deliveries of the cement and of its use in work. Copies of these records shall be supplied to the Engineer.

## **4.2 AGGREGATES:**

- a. "Aggregate" in general designates both fine and coarse inert materials used in the manufacture of concrete.
- b. "Fine Aggregate" is aggregate most of which passes through 4.75 mm IS sieve.
- c. "Coarse Aggregate" is aggregate most of which is retained on 4.75 mm IS sieve.

**4.2.2** All fine and coarse aggregates proposed for use in work shall be subject to the Engineer's approval and after specific materials have been accepted, the source of supply of such materials shall not be changed without prior approval of the Engineer.

**4.2.3** All fine coarse aggregates used in concrete subject to temperature higher than 176 C shall be limestone aggregates and calcareous sands or slag.

**4.2.4** Aggregates shall, except as noted, consist of natural sands, crushed stone and gravel from a source to produce satisfactory aggregates for concrete and shall be alchemical inert, strong, hard, durable against weathering, or limited porosity and free from deleterious materials that may cause corrosion of the reinforcement or may impair the strength and / or durability of concrete. The grading of aggregates should be such as to produce a dense concrete of specified strength and consistency that will work readily into position without segregation and shall be based on the "mix design" and preliminary tests on concrete specified later.

#### **4.2.5 SAMPLING AND TESTING**

Sampling of the aggregates for mix design and determination of suitability shall be taken under the supervisions of the Engineer and delivered to the laboratory, well in advance of the scheduled placing of concrete. Records of tests which have been made on proposed aggregates and on concrete made from this source of aggregates shall be furnished to the Engineer in advance of the work for use in determining aggregate suitability.

#### **4.2.6 STORAGE OF AGGREGATES**

All coarse and fine aggregates shall be stacked separately in stock piles in the material yard near the work site in bins properly constructed to avoid inter mixing of different aggregates. Contamination with foreign materials during storage and while heaping the materials shall be avoided. The aggregate must be of specified quality not only at time of receiving at site but so at the time of loading into mixer. Rakers shall be used for lifting the coarse aggregates from bins or stock piles. Coarse aggregate shall be piled in layers not exceeding 1.20 meters in height to prevent coning or segregation. Each layer shall cover the entire area of the stock pile before succeeding layers are started. Aggregates that have become segregated shall be rejected. Rejected materials after remixing may be accepted, if subsequent tests demonstrate conformance with required gradation.

#### **4.2.7 SPECIFIC GRAVITY**

Aggregates having a specific gravity below 2.6 (saturated surface dry basis ) shall not be used without special permission of the Engineer.

### **5. FINE AGGREGATE**

Fine aggregate except as noted above, and for other than light weight concrete shall consist of natural or crushed sand to I.S. 383. The sand shall be clean, sharp, hard, strong and durable and shall be free from dust, vegetable substance, adherent coating, clay, loam, alkali, organic, matter, mica/a, salt or other deleterious substances, which can be injurious to the setting qualities/ strength / durability of concrete.

#### **5.1 MACHINE MADE SAND**

Machine made sand will be acceptable, provided the constituent rock /"gravel composition shall be sound, hard, dense, non organic, uncoated and durable against weathering.

## 5.2 SCREENING AND WASHING

Sand shall be prepared for use by such screening or washing, or both as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions.

## 5.3 FOREIGN MATERIALS LIMITATIONS

The percentage of deleterious substances in sand delivered to the mixer shall not exceed the following:

**TABLE – 1**

		Percentage by Weight	
		Uncrushed	Crushed
i.	Material finer than 75 micron I.S. Sieve	3.00	15.00
ii.	Shale	1.00	-
iii.	Coal and lignite	1.00	1.00
iv.	Clay lumps	1.00	1.00
v.	Total of all above substances including items (i) to (iv) for uncrushed sand items (iii) and (iv) for crushed sand	5.00	2.00

## 5.4 GRADATION

Unless otherwise directed or approved, the grading of sand shall be within the limits indicated in table-2.

Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron IS sieve, by total amount not exceeding 5 percent, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron I.S. Sieve or to percentage passing any other sieve size on the coarser limit of Grading zone - I or the limit of Grading zone - IV. Fine aggregates conforming to Grading zone - IV shall not be used unless mix designs and preliminary tests have shown its suitability for producing concrete of specified strength and workability.

## 5.5 FINENESS MODULES

The sand shall have a fineness modules of not less than 2.2. or more than 3.2. The fineness modules is determined by adding the cumulative percentages retained on the following US. Sieve sizes (4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron) and dividing the sum by 100.

## 6.0 COARSE AGGREGATES

Coarse aggregate for concrete, except as noted above and for other than light weight concrete shall conform to I.S. 383. This shall consist of natural or crushed stone and gravel and shall be clean, and free from elongated flaky or laminated pieces, adhering coatings, clay lumps, coal residue, clinkers, slag, alkali, mica, organic matter or other deleterious matter.

## 6.1 SCREENING AND WASHING

Natural gravel and crushed rock shall be screened and /or washed for the removal of dirt, or dust coating, vegetable and objectionable amounts of other foreign matters, if so demanded by Engineer.

**6.2.1** Coarse aggregates shall be either in single size or graded in both side, the grading shall be within the limits indicated in table - 3.

**6.2.2** The pieces shall be angular in shape and shall have granular or crystalline, surfaces. Friable, flaky and laminated pieces, mica and shale, if present, shall be only in such quantities that will not, in the opinion of Engineer, affect adversely the strengthened / or durability of concrete. The maximum size specified above, but in no case greater than 1/4 of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the comers of the form. Plums above 160 mm and up to any reasonable size can be used in plain mass concrete work of large dimensions up to a maximum limit of 20% by volume of concrete when specifically approved by Engineer. For heavily reinforced concrete members, the nominal maximum size of the aggregate shall be 5 mm less than the minimum clear distance between the reinforcing main bars or 5 mm less than the minimum cover to the reinforcement whichever is smaller. The amount of fine particles occurring in the free state or as loose adherent shall not exceed 1 % when determined by laboratory sedimentation tests as per I.S. 2306. After 24 hours immersion in water, a previously dried sample shall not have gained more than 10% of its oven dry weight in air, as determined by I.S. 2306.

**TABLE - 2**  
**PERCENTAGE PASSING FOR**

<b>IS Sieve Designation</b>	<b>Grading Zone I</b>	<b>Grading Zone II</b>	<b>Grading Zone III</b>	<b>Grading Zone IV</b>
10 mm	100	100	100	100
4.75 mm	90 – 100	90 – 100	90 – 100	90 – 100
2.36 mm	60 – 95	75 – 100	85 – 100	95 – 100
1.18 mm	30 – 70	55 – 90	75 – 100	90 – 100
600 micron	15 – 34	35 – 59	60 – 79	80 – 100
300 micron	5 – 20	8 – 30	12 – 40	15 – 40
150 micron	0 – 10	0 – 10	0 – 10	0 – 10

**TABLE 3**

<b>IS Sieve Designation</b>	<b>Percentage passing for single sized aggregate of nominal size</b>					<b>Percentage passing for graded aggregate of nominal size</b>			
	<b>40 mm</b>	<b>20 mm</b>	<b>16 mm</b>	<b>12.5 mm</b>	<b>10 mm</b>	<b>40 mm</b>	<b>20 mm</b>	<b>16 mm</b>	<b>12.5 mm</b>
63 mm	100	-	-	-	-	100	-	-	-
40 mm	85-100	100	-	-	-	95-100	100	-	-
20 mm	0-20	85-100	100	-	-	30-70	95-100	100	-
16 mm	-	-	85-100	100	-	-	-	90-100	-
12.5 mm	-	-	-	85-100	100	-	-	-	90-100
10 mm	0-5	0-10	0-30	0-45	85-100	10-35	25-55	30-70	40-85
4.75 mm	-	0-5	0-5	0-10	0-20	0-5	0-10	0-10	0-10
2.36 mm	-	-	-	-	0-5	-	-	-	-

**6.3 FOREIGN MATERIALS LIMITATIONS**

The percentages of deleterious substances in the coarse aggregate delivered to the mixer shall not exceed the following :-

**TABLE – 4**

		Percentage by Weight	
		Uncrushed	Crushed
i.	Material finer than 75 micron I.S. Sieve	3.00	15.00
ii.	Coal and lignite	1.00	1.00
iii.	Clay lumps	1.00	1.00
iv.	Soft fragments	3.00	-
v.	Total of all the above substances	5.00	5.00

## 7.0 WATER

**7.1** Water used for both mixing and curing shall be free from injurious amounts of deleterious materials. Potable waters are generally satisfactory for mixing and curing concrete.

**7.2** In case of doubt, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time test specified in IS : 456. The sample of water taken for testing shall be typical of the water proposed to be used for concreting, due account being paid to seasonal variation. The sample shall not receive any treatment before testing other than that envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.

**7.3** Average 28 days compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not to be less than 90% of the average strength of three similar concrete cubes prepared with distilled water.

**7.4** The initial setting time of test block made with the appropriate test cement and the water proposed to be used shall not be less than 30 minutes and shall not differ by more than + / - 30 minutes from the initial setting time or control test block prepared with appropriate test cement and distilled water. The test blocks shall be prepared and tested in accordance with the requirements of I.S.4031 .(Part-5)

**7.5** Where water can be shown to contain an excess of acid, alkali, sugar or salt. Engineer may refuse to permit its use. As a guide, the following concentrations represents the maximum permissible values :-

- a) to neutralise 100 ml sample of water using phenolphthalein as indicator, it should not require more than 5 ml of 0.02 Normal NaOH. The detail of test shall be as given in IS : 3025. (Part-22)
- b) To neutralise 100 ml sample of water, using methyl orange as an indicator, it should not require more than 25 ml of 0.02 Normal H<sup>+</sup>SO<sup>+</sup>. The details of test shall be given in 8 of I.S. 3025. (Part-23)
- c) Percentage of solids, when tested in accordance with the method indicated below, shall not exceed the following :-

**TABLE - 5**

Solids	Permissible Limit	Method of Test (Ref. to Part No. in I.S. : 3025)
Organic	200 mg / l	Part – 18

Inorganic	3000 mg / l	Part – 18
Sulphates (as SO <sub>3</sub> )	400 mg / l	Part – 24
Alkali Chlorides (as Cl)	500 mg / l	Part – 32
Suspended matter	2000 mg / l	Part – 17

## **7.6 SUPPLY PRESSURE :**

Clean water in pipes under pressure shall be provided by the contractor with all necessary equipments giving a nozzle pressure of not less than 2 kg/cm<sup>2</sup> for the convenient and effective jetting for rock foundation and concrete surfaces for curing concrete and other requirements.

## **7.7 FIRE PROTECTION SYSTEM**

Contractor shall provide and maintain at all times adequate fire protection system to protect his equipment, materials and construction. In emergency, the contractor shall permit the government to use the system for protecting equipment, works etc. on the project.

## **8. REINFORCEMENT**

8.1 Reinforcement bars, if supplies are arranged by Contractor, shall be either plain round mild steel bars. Grade I as per I.S. : 432 (part I) or medium tensile steel bars as IS : 432 (Part I) or hot rolled mild steel and medium tensile steel deformed bars as per IS.: 1139 or cold twisted steel bars and high yield strength deformed bars as per I.S.: 1786, as shown and specified on the drawings. Wire mesh or fabric shall be in accordance with I.S.: 1566. If desired by Engineer-in-Charge, contractor shall procure & use 'TMT' bars unless supply is made by the Engineer as per Schedule-A. As per IS. : 456-2000 reinforcement be as per IS. : 2062 grade 'A'. Substitution of reinforcement will not be permitted except with written approval from Engineer.

### **8.2 STORAGE**

The reinforcement shall not be kept in direct contact with ground but stacked on top of an arrangement or timber sleepers or the like, reinforcement shall be coated with cement wash before stacking to prevent scale and rust. Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deterioration.

### **8.3 QUALITY**

**8.3.1** All steel shall be of Grade I quality specifically permitted by the Engineer. No rerolled material will be accepted. If demanded by the Engineer, Contractor shall submit the manufacturer's test certificate for steel. Random tests on steel supplied by Contractor may be performed by owner as per relevant Indian Standards. All costs incidental to such tests shall be at "Contractor's expense. Steel not conforming to specifications shall be rejected.

**8.3.2** All reinforcement shall be clean, free from grease, oil paint, dirt, loose mill scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used. All bars shall be rigidly held in position before concreting. No welding of rods to obtain continuity shall be allowed unless approved by the Engineer. If welding is approved, the work shall be carried out as per I.S. : 2751 accordingly to best modern practices and as directed by the Engineer. In all cases of important connections, tests shall be made to prove that the joints are of the full strength of bars welded. Special precautions, as specified by the Engineer, shall be taken in the welding of cold worked reinforcing bars and bars other than mild steel. The contractor shall bear related to the test of joints etc.

### **8.4 LAPS**

Laps and splices for reinforcement shall be as shown on the drawings. Splices in adjacent bars shall be staggered and the locations of all splices, except those specified on the drawings, shall be approved by the Engineer. The bars shall not be lapped unless the length required exceeds the maximum available length of bars at site.

## **8.5 BENDING**

All bars shall be accurately bent accordingly to the sizes and shapes on the detailed workings drawing/ bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and recent in a manner that will injure the materials, bars containing cracks or splits shall be rejected. They shall be bent cold except bars of over 25 mm in diameter which may be bent hot if specifically approved by the Engineer. Bars which depend for their strength on cold working, shall not be bent hot. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 645 C ) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only if the means used for straightening and rebinding be such as shall not in the opinion of the Engineer injure the material. No reinforcement shall be bent when in position the work without approval whether or not it is partially embedded in hardened concrete. Bars having kinks or bends other than those required by design shall not be used.

## **8.6 FIXING**

Reinforcement shall be accurately fixed by any approved means and maintained in the correct position shown in the drawings by the use of blocks, spacers and chairs as per I.S.: 2502 to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be securely bound together at all such points with number 16 gauge annealed soft iron wire. The vertical distances required between successive layers of bars in beams or similar members shall be maintained by the provision of spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

## **8.7 COVER**

Unless indicated otherwise on the drawings, nominal cover means design depth of cover for all reinforcement including links but exclusive of plaster or other decorative finish shall be as follows : -

- a) At each end of reinforcing bar, not less than 25 mm nor less than twice the diameter of the bar.
- b) For a longitudinal reinforcing bar in a column, not less than 40 mm, nor less than the diameter of the bar. In case of columns of minimum, dimension of 20 cm, or under, with reinforcing bars of 12 mm diameter, a cover of 25 mm may be used.
- c) For longitudinal reinforcing bars in a beam, not less than 25 mm nor less than the diameter of the bar.
- d) For tensile, compressive, shear or other reinforcement in a slab or wall not less than 20 mm or less than the diameter of such reinforcement.
- e) For any other reinforcement not less than 15 mm, nor less than the diameter of such reinforcement.
- f) For footings and other principal structural members in which the concrete is deposited directly against the ground, cover to the bottom reinforcement shall be 75 mm. If concrete is poured on a layer of lean concrete the bottom cover may be reduced to 50 mm.
- g) For concrete surfaces exposed to the weather or the ground after removal of forms, such as retaining walls, grid beams, footing sides and top etc., not less than 50 mm for bars larger than 16 mm dia, and not less 0-40 mm for bars 16 mm dia or smaller.



h) Increased cover thickness shall be provided, as indicated on the drawings, for surfaces exposed to the action of harmful chemicals (or exposed to earth contaminated by such chemical) acid, alkali, saline atmosphere, sulphurous smoke etc.

i) For reinforced concrete members, totally or periodically immersed in sea water or subject to sea water spray the cover of concrete shall be 50 mm more than those specified in (a) to (e) above.

j) Protection to reinforcement in case of concrete exposed to harmful surroundings may also be given by providing a dense impermeable concrete with approved protective coating, as specified on the drawings. In such a case the extra cover, mentioned in (h) and (i) above, may be reduced by the Engineer, to those shown on the drawings.

k) The correct cover shall be maintained by cement mortar briquette or other approved means. Reinforcement for footings, grid beams and slabs on subgrade shall be supported on precise concrete blocks as approved by the Engineer. The use of pebbles or stones shall not be permitted.

l) Nominal cover in any case shall be greater of following or what is indicated above.

Exposure	Main Cover
Mild	20 mm
Moderate	30 mm
Severe	45 mm
Very Severe	75 mm

For reduction in cover notes of I.S. 456-2000 table 60 will be applicable

m) The minimum clear distance between reinforcing bars shall be in accordance with I.S. : 456 or as shown in drawings.

## 8.8 INSPECTION

Erected and secured reinforcement shall be inspected and approved by the Engineer prior to placement or concrete.

## 8.9 PAYMENT

Supply of reinforcement steel will be governed by the conditions stipulated in Schedule 'A'. For the purpose of payment weight will be calculated on the basis of bar bending schedule and weight of bars as per table given below :-

**TABLE - 6**

Bar Diameter	Weight (in kg / meter)
6 mm	0.222
8 mm	0.395
10 mm	0.617
12 mm	0.888
16 mm	1.579
20 mm	2.467
22 mm	2.985
25 mm	3.855

28 mm	4.836
32 mm	6.316
36 mm	7.994
40 mm	9.868

Whenever actual lengths placed differ from bar bending schedule, actual lengths will only be measured. For payment of work done under this item the actual quantity of steel embedded in concrete as calculated and approved by the Engineer irrespective of the level or the height at which the work is done shall be taken. Dowels and Laps as shown in drawings or as approved by Engineer, minimum number of chairs and spacer bars to keep the reinforcement in place, pins as approved by Engineer shall be measured and paid for.

No payment will however, be made for binding wire.

## **9. STEEL SHAPES ENCASED IN CONCRETE**

Structural steel columns, beams, girders and bracings to be encased in concrete shall be unpainted, if so indicated on the drawings. The encasing shall be done in concrete with 10mm maximum size aggregate sand a works cube strength not less than 15 N/m<sup>2</sup> at 28 days unless otherwise specified in drawings. The steel member shall be wrapped with galvanised wire mesh of the size indicated on the drawings. The galvanised wire mesh shall be kept 20 mm from the edge of surface of the steel member shall be held in position securely. The steel member will have a minimum cover of 50 mm unless otherwise indicated on the drawings. Where the clear cover to steel is more than 75 mm.. mild steel bar and concrete with 20 mm coarse aggregate can be used.

## **10. DESIGN MIX CONCRETE**

**10.1** All RCC work shall be "Design Mix Concrete" only. The contractor shall make all the necessary tests to determine for each grade of concrete, the proportion of various ingredients by which to arrive at the desired design mix to the satisfaction of the Engineer. Such mix will be known as the 'Declared Mix'. No deviation from the 'Declared Mix' will be permitted without the express sanction of the Engineer in writing. No agreement by the Engineer to such 'Declared Mix' shall relieve the contractor of his responsibility to use in the works at all times only concrete as specified in the relevant drawings. Contractor shall also see that the mix design so approved by the Engineer shall be established at site by taking sufficient cubes at site and testing the same as directed by the Engineer.

**10.2** The contractor shall be entirely responsible for design for design of concrete mixes of the specified performance to suit the degree of workability and characteristic strengths required for the various parts of the works.

**10.3** Concrete shall meet with the strength requirements and minimum cement contents as indicated in table hereinafter.

**10.4** Alternative mixes may be designed by the contractor for use in both thin and narrow sections and thick sections. Special mixes using finer aggregates may be designed by him for infilling pockets and narrow spaces and for regions of congested reinforcement.

## Minimum Compressive Strength of 15 cm Cubes at 7 & 28 Days After Mixing Conducted in Accordance with IS : 516

**TABLE 7**

Grade of Concrete	Preliminary Test N/mm <sup>2</sup>		Maximum size of aggregate (mm)	Location for use
	At 7 days	At 28 days		
M 15	13.5	20	40 or 20	As indicated in the working drawings
M 20	17.5	26	40 or 20	- do -
M 25	22.0	32	40 or 20	- do -
M 30	25.0	38	40 or 20	- do -
M 35	30	44	20	- do -
M 40	33.5	50	20	- do -

**TABLE 7 (A)**

Minimum Cement Content, Maximum Water-Cement Ratio and Minimum Grade of Concrete for different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum Size  
(Clauses 6.1.2, 8.2.4.1 and 9.1.2)

Sl. No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum cement content kg/m <sup>3</sup>	Maximum free water cement ratio	Minimum Grade of concrete	Minimum cement content kg/m <sup>3</sup>	Maximum free water cement ratio	Minimum Grade of concrete
1.	2	3	4	5	6	7	8
1.	Mild	220	0.60	-	300	0.55	M 20
2.	Moderate	240	0.60	M 15	300	0.50	M 25
3.	Severe	250	0.50	M 20	320	0.45	M 30
4.	Very severe	260	0.45	M 20	340	0.45	M 35
5.	Extreme	280	0.40	M 25	360	0.40	M 40

### NOTES

- Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in 5.2. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (Part 1) and IS 455 respectively.
- Minimum grade for plain concrete under mild exposure condition is not specified.

**TABLE 7 (B)**

Table 3 Environmental Exposure Conditions  
(Clauses 8.2.2.1 and 35.3.2)

Sl. No.	Environment	Exposure Conditions
(1)	(2)	(3)
i)	Mild	Concrete surfaces protected against weather or aggressive conditions, except those situated in coastal area.
ii)	Moderate	Concrete surfaces sheltered from severe rain or freezing whilst wet  Concrete exposed to condensation and rain Concrete continuously under water Concrete in Contract or buried under non-aggressive soil/ground water Concrete surfaces sheltered from saturated salt air in coastal area
iii)	Severe	Concrete surfaces exposed to severe rain, alternate wetting and drying or occasional freezing whilst wet or severe condensation. Concrete completely immersed in sea water Concrete exposed to coastal environment
iv)	Very severe	Concrete surfaces exposed to sea water spray, corrosive fumes or severe freezing conditions whilst wet Concrete in contact with or buried under aggressive sub-soil/ground water
v)	Extreme	Surface of members in tidal zone Members in direct contact with liquid/solid aggressive chemical

**NOTE:** It shall be very clearly understood that whenever the class of concrete e.g. as M 20 is specified it shall be contractor's responsibility to ensure that minimum crushing strength stipulated for the respective class of concrete is obtained at works test. The maximum total quantity of aggregate by weight per 50 kg. of cement shall not exceed 350 kg. except when otherwise specifically permitted by Engineer.

## **11.0 MIX DESIGN**

**11.1.1** This is to investigate the grading of aggregate, water cement ratio, workability and the quantity of cement required to give the desired strength. The proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made. Mix proportioning shall be carried out according to the S.P. 23- Recommended guidelines.

**11.1.2** Whenever there is a change either in required strength of concrete or water-cement ration or workability or the source of aggregate and/or cement, preliminary tests shall be repeated to determine the revised proportions of the mix/proportions, over-wet mixes shall always be avoided, to suite the altered conditions.

## **11.2 PRELIMINARY TESTS**

**11.2.1** Test specimens shall be prepared with at least two difference water/cement ratios for each class of concrete, consistent with workability required for the nature of the work. The materials and proportions used in making preliminary tests shall be similar in all respects to those to be actually employed in the works as the object of these resets is to determine the proportions of cement, aggregates and water necessary to produce concrete of required consistency and to give the specified strength. It will be contractor's sole responsibility to carry out those tests and shall therefore furnish to the Engineer a statement of proportions proposed to be used for various concrete mixes. For preliminary tests, the following procedure shall be followed.

Materials shall be brought to the room temperature and all materials shall be in a dry condition. The quantities of water, cement and aggregates for each batch shall be determined by weight to an accuracy of 1 part in 1000 parts.

### **11.2.2 MIXING OF CONCRETE**

**11.2.2.1** All concrete whether design mix or nominal mix shall be mixed in an approved mixer of the type as per the following IS:

Batch type concrete mixer	:	I.S.	: 1791
Roller pan mixer	:	I.S.	: 2439

With suitable provision, for correctly controlling water delivered in the drum. **11.2.2.2** Materials for concrete shall be deposited into the mixer drum while it is in rotation in the following order:

Coarse Aggregate, Cement, Fine Aggregate and later Water.

The mixing shall be continued until there is a uniform distribution of the materials yielding a mix of uniform colour and consistency. The mixing shall be done for 1 1/2 to 2 minutes and a minute extra if hydro-phobic cement is used.

**11.2.2.3** The volume of mixed material shall not exceed the manufacturer's rate mixer capacity.

**11.2.2.4** Temperature of aggregate, water and cement when added to the mixer shall be such that the temperature of the concrete at the time of placement is less than 40 C.

**11.2.2.5** The mixer shall be thoroughly cleaned of all hardened sticking concrete and foreign materials before beginning the concreting operations and also at frequent intervals between batches and at the end of concreting' work by spraying the drum with cool water.

**11.2.2.6** Concrete shall be discharged from the mixer on to a level, clean and water-tight surface. The area surrounding the mixer and the aggregate stacks shall be kept clean.

**11.2.2.7** Subject to the approval of the Engineer, the contractor may use waterproofing admixtures and/or other chemical admixtures and additives in concrete. The proportions and the mode of use shall be as per the manufacturer's instructions. The contractor shall furnish complete literature in regard to such admixtures/ additives to the Engineer.

**11.2.2.8** Mixing of cement mortar or concrete which has partially set shall not be permitted under any circumstances.

### **11.2.3 PLACING**

**11.2.3.1** When not weather conditions exists, the concrete shall be transported in as short a time as possible and placed in the forms and consolidated to final state.

**11.2.3.2** As far as possible, concrete shall be placed during cool hours and in case, the temperature exceeds 40° C in the day, contractor shall have to do concreting in cool hours or even at night.

#### 11.2.4 CONSISTENCY

The consistency of each batch of concrete shall be measured immediately after mixing, by the slump - test in accordance with I.S.: 1199. If in the slump test, care is taken to ensure that no water or other material is lost, the material used for the slump test may be remixed with the remainder of the concrete for making the specimen test cubes. The period of re-mixing shall be as short as possible yet sufficient to produce a homogeneous mass.

#### 11.2.5 SIZE OF TEST CUBES

Compression tests of concrete cubes shall be made as per I.S.:516 on 15 cm cube. Each mould shall be provided with a metal base plate having a plane surface so as to support the mould during filling without leakage, the base plate shall be preferably attached to the mould by springs or screws. The parts of the mould when assembled shall be positively and rigidly held together. Before placing of concrete, the mould and base plate shall be cleaned and oiled. The dimensions and internal faces of the mould shall be accurate within the following limits.

Height and distances between the opposite faces of the mould shall be of specified size  $\pm 0.2$  mm. The angle between the adjacent internal faces and between internal faces and top and bottom planes of mold shall be  $90 \pm 0.5$ . The interior faces of the mould shall be plain surfaces with a permissible variation of 0.03 mm.

#### 11.2.6 COMPACTING

Concrete test cubes shall be moulded by placing fresh concrete in the mould and compacted as specified in I.S.:516.

**11.2.7** Curing shall be as specified in I.S.:516. The cubes shall be kept in moist air or at least 90% relative humidity as a temperature of  $27 \pm 2$  C for 24 hours + 1/2 hour from the time of adding water to the dry ingredients. Thereafter, they shall be removed from the moulds and kept immersed in clean and fresh water and kept at  $27 \pm 2$  C. Temperature until required for test. Curing water shall be renewed every seven days. A record of maximum and minimum temperature at the place of storage of the cubes shall be maintained during the period they remain in storage.

**11.2.8** The characteristic strength shall be determined based on the assumed standard deviation. The suggested value of the standard deviation shall be as given in the table below: -

**TABLE - 8**  
**Assumed Standard Deviation**  
**(Clause 9.2.4.2 and Table 11)**

Grade of Concrete	Assumed Standard Deviation (N/mm <sup>2</sup> )
M 10 M 15	3.5
M 20 M 25	4.0
M 30 M 35 M 40 M 45	5.0

**NOTE** - The above values correspond to the site control having proper storage of cement; weigh batching of all materials; controlled addition of water; regular checking of all materials, aggregate gradings and moisture content; and periodical checking of workability and strength. Where there is deviation from the above the values given in the above table shall be increased by IN/mm<sup>2</sup>

**11.2.9** The characteristic strength shall be determined based on the assumed standard deviation as given in IS: 456. All the laboratory test results shall be tabulated and furnished to the Engineer. The test results shall be accepted by the Engineer, if the standard deviation obtained from actual strength of test specimen is within those specified IS: 456. The standard deviation of concrete of a given grade shall be calculated as follow :-

$$\text{Estimated standard deviation } S = \sqrt{(\sum \Delta^2 / n-1)}$$

Where  $\Delta$  = Deviation of individual test strength from average strength of 'n' sample

n = Number of sample test results, which shall be around 30.

**11.2.10** The Engineer may direct contractor to repeat the if the result are not satisfactory and also to make such changes as considered necessary. All these preliminary tests shall be conducted by contractor at his/their own cost and in approved laboratory.

## **12.0 PROPORTIONING, CONSISTENCY, BATCHING AND MIXING OF CONCRETE**

### **12.1 PROPORTIONING**

#### **12.1.1 AGGREGATE**

The proportions which shall be decided by conducting preliminary tests shall be by weight. These , proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete batching by means of weight batches conforming to I.S.: 2722 capable of controlling the weights within one percent of the desired value. Except where it can be shown to the satisfaction of the Engineer that supply of property graded ' aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stocked in separate stock piles. The grading of coarse and fine aggregate shall be checked as frequently as possible, as determined by the Engineer, to ensure maintaining of grading in accordance with the sample used in preliminary mix design.. The material shall be stocked piled well in advance of use.

#### **12.1.2 CEMENT**

The cement shall be measured by weight.

#### **12.1.3 WATER**

Only such quantity of water shall be added to the cement and aggregates in the concrete mix as to ensure dense concrete, specified surface finish, satisfactory workability, consistent with the strength stipulated for each class of concrete. The water added to the mix shall be such as net to cause segregation of materials or the collection of excessive free water on the surface of the concrete.

#### **12.1.4 DEFINITION OF WATER/CEMENT RATIO**

The water cement (W/C) ratio is defined as the weight of water in the mix (including the surface ,, moisture of the aggregates) divided by the weight of cement in the mix.

### 12.1.5 WATER/CEMENT RATIO

The actual water cement ratio to be adopted shall be determined in each instance by contractor and approved by the Engineer.

### 12.1.6 PROPORTIONING BY WATER/CEMENT RATIO

The W/C ratio specified for use by the Engineer shall be maintained. Contractor shall determine the water content of the aggregate as frequently as directed by the engineer as the work progresses and as specified in I.S.:2386 (Part-III) and the amount of mixing water added at the mixer shall be adjusted as directed by the Engineer as to maintain the specified W/C ratio. To allow for the variation in weight of aggregates due to variation in their moisture content, suitable adjustments in the weights of aggregates shall also be made.

### 12.2 CONSISTENCY AND SLUMP

**12.2.1** Concrete shall be of a consistency and workability suitable for the conditions of the job. After the amount of water required is determined, the consistency of the mix shall be maintained throughout the progress of the corresponding parts of the work and approved tests e.g. slump tests, compacting factor tests, in accordance with I.S.:199 shall be conducted from time to time to ensure the maintenance of such consistency.

**12.2.2** The following tabulation gives a range of slumps which shall generally be used for various types of construction unless otherwise instructed by the Engineer.

**TABLE - 9**  
**SUGGESTED RANGES OF VALUES OF WORKABILITY OF CONCRETE FOR**  
**DIFFERENT PLACING CONDITIONS.**

Placing conditions	Values of workability	Degree of workability
Concreting of shallow sections with vibration	Very low	20-10 seconds, Vee-Bee time or 0.75 - 0.80, compacting factor
Concreting of highly reinforced with vibration	Low	20 - 25 seconds, Vee-Bee time or 0.80 - 0.85, compacting factor
Concreting of highly reinforced sections without vibrations, or heavily reinforced sections with vibration	Medium	05 - 02 seconds, Vee-Bee time or 0.85 - 0.92, compacting factor or 25 - 75 mm, slump for 20 mm aggregate
Concreting of heavily reinforced sections with vibration	High	Above 0.92, compacting factor or 75 - 125 mm, slump for 20 mm aggregate

Alternatively, if permitted by the Engineer-in-charge, the following values of slump may be used for various types of construction.



**TABLE 10**  
**SLUMPS FOR VARIOUS TYPES OF CONSTRUCTION**

	<b>Slump in millimetres</b>	
	<b>Maximum</b>	<b>Minimum</b>
Reinforced foundation wells and footings	75	25
Plain footings, caissons and sub-structure walls	75	25
T.G. and massive compressor foundations	50	25
Slabs, Beams and reinforced walls	100	25
Pumps and miscellaneous equipment foundations	75	25
Building columns	100	25
Pavements	50	25
Heavy mass construction	50	25

### **12.3 BATCHING AND MIXING CONCRETE**

**12.3.1** The materials and proportions of concrete materials as established by the preliminary tests for the mix design shall rigidly followed for all concrete on the project and shall not be charged except when specifically permitted by Engineer.

**12.3.2** Concrete shall be produced only by weight batching the ingredients. The mixer and weigh batches shall be maintained in a clean serviceable condition. The accuracy of weigh batches shall be periodically checked. They shall be set up level on a firm base and the hopper shall be loaded evenly. The needle shall be adjusted to zero when the hopper is empty. Fine and coarse aggregates shall be weighed separately. Volume batching will not be permitted. However, Engineer may permit volume batching by subsequent conversion of the weights of the aggregate into their equivalent volumes knowing their bulk densities. Concrete shall be of strength stipulated in the respective item. All concrete shall be mixed in mechanically operated batch mixers complying with IS: 1791 and of approved make with suitable provision for correctly controlling the water delivered to the drum. The quantity of the water actually entering the drum shall be checked with reading of the gauge or valve setting, when starting a job. The test should be made while the mixer is running. The volume of the mixed material shall not exceed the manufacturer's rates mixer capacity. The batch shall be charged into the mixer so that some water will enter the drum in advance of cement and aggregates. All water shall be in the drum by the end of the first 15 seconds of the specified mixing time. Each batch shall be mixed until the concrete is uniform in colour, for a minimum period of two minutes after all the materials and water are in the drum. The entire contents of the drum shall be discharged in one operation before the raw materials for succeeding batches are fed into the drum.

**12.3.3** Each time the work stops, the mixer shall be cleaned out and when next commencing the mixing, the first batch shall have 10% additional cement to allow for sticking in the drum.

### **13. SAMPLING AND TESTING CONCRETE IN THE FIELD**

Facilities required for sampling materials and concrete in the field if Engineer so desires shall be provided by Contractor at no extra cost. The following equipment with operator shall be made available at Engineer's request (all must be in serviceable condition):

1. Cast iron cube moulds 15 cm. size : 6 Nos.(min.)

- |     |  |   |             |
|-----|--|---|-------------|
| 2.  | Slump cone complete with tamping rod                                 | : | 1 set       |
| 3.  | Laboratory balance to weigh upto 5 kg. with<br>Sensitivity of 10 gm. | : | 1 No.       |
| 4.  | I.S. sieve for coarse and fine aggregates                            | : | 1 Set       |
| 5.  | A set of measures from 5 < 1 to 0.11                                 | : | 1 Set       |
| 6.  | Electric oven with thermostat upto 120                               | : | 1 No.       |
| 7.  | Pycometer  | : | 1 No.       |
| 8.  | Calibrated glass jar 1 liter capacity                                | : | 2 Nos.      |
| 9.  | Glass flasks and metal containers                                    | : | As required |
| 10. | Laboratory balance of 2 kg. capacity and of<br>sensitivity of 1 gm.  | : | 1 No.       |
| 11. | Thermometer  | : | As required |

### 13.1 CONSISTENCY

'Slumps test shall be carried out as often as demanded by Engineer and invariable from the same batch of concrete from which the test cubes made. Slump test shall be done immediately after sampling.

### 13.2 SAMPLING AND STRENGTH OF CONCRETE

During the process of Concrete, six nos. of 15 cm. cube specimens shall be made for each sampling. Sampling and testing shall be made in accordance with latest IS: 1199 and 516. Minimum frequency of sampling shall be as follows:

Quantity of concrete in the work (cum)	Number of Samples
1 - 5	1
6 - 15	2
16 - 30	3
31 - 50	4
51 - and as above	4 plus 1 additional sample for each additional 50 cum or pan thereof.

At least one sample shall be taken from each shift. Out of the six specimens taken from each sample. Three specimens shall be kept for test for compressive strength of 28 days. The remaining three cubes shall be tested for seven days compressive strength or at the time of striking the form work. The test strength of the sample shall be the average of these specimens. The minimum requirement of compressive strength for 7 days test shall be as indicated in clause 10.

In all cases the 28 days compressive strength specified in clause 10 shall alone be the criteria for acceptance or rejection of concrete.

#### **14. ADMIXTURE**

No admixture shall be used without prior approval of the Engineer. Admixtures in solution shall be stored in suitable containers at a temperature not lower than 10° F and approved mechanical agitators shall be used to agitate the admixture solutions prior to and during mix. No payment shall be made for the use of admixtures.

**14.1** Admixture, if used shall comply with I.S. 9103. Previous experience with and data on such materials should be considered in relation to the likely standards of supervision and workmanship to the work being specified.

**14.2** Admixtures should not impair durability of concrete nor combine with the constituent to form harmful compounds nor increase the risk of corrosion of reinforcement.

**14.3** The workability, compressive strength and the slump loss of concrete with and without the use of admixtures shall be established during the trial mixes before use of admixtures.

**14.4** The relative density of liquid admixtures shall be checked for each drum containing admixtures and compared with the specified value before acceptance.

**14.5** The chloride content of admixtures shall be independently tested for each batch before acceptance.

**14.6** If two or more admixtures are used simultaneously in the same concrete mix, data should be obtained to assess their interaction and to ensure their compatibility.

#### **15. TESTS**

**15.1** Contractor will have to carry out regular test in accordance with the relevant Indian Standards for aggregates, coarse and fine, as detailed below under direction of the Engineer. The contractor shall bear all costs related to test.

##### **A. COARSE AGGREGATE:**

Tests on coarse aggregate shall be include.

- (i) Sieve analysis.
- (ii) Specific gravity and unit weight of dry loose and rodded aggregate.
- (iii) Soundness and alkali aggregate reactivity.
- (iv) Petrographic examination.
- (v) Deleterious materials and organic impurities.
- (vi) Test for aggregate crushing value.

##### **B. FINE AGGREGATE :**

Tests on sand include

- (i) Sieve test,
- (ii) Test for organic impurities.

- (iii) Decantation test for determining clay and silt content,
- (iv) Specific gravity test.
- (v) Test for unit weight and bulkgage factor.
  
- (vi) Test for sieve analyses and fineness modules.

Following test for cement shall be carry out for every batch of cement brought at site.

- (i) Fineness test,
- (ii) Test for normal consistency,
- (iii) Test for setting time,
- (iv) Test for soundness,
- (v) Test for tensile strength.
- (vi) Test for compressive strength,
- (vii) Test for heat of hydration by experiment and by calculations in accordance with IS : 269.

Any or all these tests would normally be ordered to be carried out only if Engineer feels the materials are not in accordance with the specifications or if the specified concrete strength are not obtained and shall be performed by contractor at an approved test laboratory. Contractor shall be all expenditure elated to tests.

**15.2** In case of failure of concrete cubes or in case the Engineer feels that the structure may not be safe. Engineer reserves the right to ask contractor to dismantle such portion of the work, which in his opinion are unacceptable and redo the work, as per specifications at contractor's cost. However, Engineer may ask the contractor to carry out non-destructive tests such as Load Test, Core Test, Hammer Test, Ultrasonic Test etc. & if the tests are successful, the structure may be accepted.

A record of all such tests shall be kept by the contractor and Engineer's signature shall be obtained on all the records. The cost of all the above shall be borne by the contractor.

### **15.3 ACCEPTANCE OF CONCRETE**

The Engineer shall inspect the concrete after stripping of the form work, to ensure that there are no apparent defects such as

- i) Improper compaction of concrete, especially at locations where placing of concrete is difficult, like the corners of the forms, at places where reinforcement is heavy etc.
- ii) Any other defects, affecting the properties of concrete, as structural member.
- iii) Appearance of the concrete.

Concrete shall be accepted by the Engineer, if it is found satisfactory in the inspection as above and compressive strength of the specimen tested at 28 days, fulfils the requirement of Acceptance Criteria as given below.

### **15.4 ACCEPTANCE CRITERIA :**

#### **15.4.1 Compressive Strength**

The concrete shall be deemed to comply with the strength requirements when both the following conditions are met:

- a) The mean strength determined from any group of four consecutive test results complies with the appropriate limits in col 2 of Table 11
- b) Any individual test result complies with the appropriate -limits in col 3 of Table 11.

#### **15.4.2 Flexural Strength**

When both the following conditions are met, the concrete complies with the specified flexural strength.

- a) The mean strength determined from any group of four consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm
- b) The strength determined from any test result is not less than the specified characteristic strength less 0.3 N/mm<sup>2</sup>

#### **15.4.3 Quantity of Concrete Represented by Strength Test Results**

The quantity of concrete represented by a group of four consecutive test results shall include the batches from which the first and last samples were taken together with all intervening batches. For the individual test result requirements given in col 3 of Table 11 or in item (b) of 15.4.2, only the particular batch from which the sample was taken shall be at risk.

Where the mean rate of sampling is not specified the maximum quantity of concrete that four consecutive test results represent shall be limited to 60 m.

**15.4.4** If the concrete is deemed not to comply pursuant to 15.4.3, the structural adequacy of the parts affected shall be investigated (see 17) and any consequential action as needed shall be taken.

**15.4.5** Concrete of each grade shall be assessed separately.

**15.4.6** Concrete is liable to be rejected if it is porous or honey-combed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met. However, the hardened concrete may be accepted after carrying out suitable remedial measures to the satisfaction of the engineer-in-charge.

### **15.5 INSPECTION AND TESTING OF STRUCTURES**

#### **15.5.1 Inspection**

To ensure that the construction complies with the design an inspection procedure should be set up covering materials, records, workmanship and construction.

**15.5.1.1** Tests should be made on reinforcement and the constituent materials of concrete in accordance with the relevant standards. Where applicable, use should be made of suitable quality assurance schemes.

**15.5.1.2** Care should be taken to see that:

- a) Design and detail are capable of being executed to a suitable standard, with due allowance for dimensional tolerances;
- b) There are clear instructions on inspection standards;

- c) There are clear instructions on permissible deviations;
- d) Elements critical to workmanship, structural performance, durability and appearance are identified; and
- e) There is a system to verify that the quality is satisfactory in individual parts of the structure, especially the critical ones.

**15.5.2** Immediately after stripping the formwork, all concrete shall be carefully inspected and any defective work or small defects either removed or made good before concrete has thoroughly hardened.

### **15.5.3 Testing**

In case of doubt regarding the grade of concrete used, either due to poor workmanship or based on results of cube strength test, compressive strength tests of concrete on the basis of 17.4 and/or load test (see 17.6) may be carried out.

### **15.5.4 Core Test**

**15.5.4.1** The points from which cores are to be taken and the number of cores required shall be at the discretion of the engineer-in-charge and shall be representative of the whole of concrete concerned. In no case, however, shall fewer than three cores be tested.

**15.5.4.2** Cores shall be prepared and tested as described in IS 516.

**15.5.4.3** Concrete in the member represented by a core test shall be considered acceptable if the average equivalent cube strength of the cores is equal to at least 85 percent of the cube strength of the grade of concrete specified for the corresponding age and no individual core has a strength less than 75 percent.

**15.5.5** In case the core test results do not satisfy the requirements of 17.4.3 or where such tests have not been done, load test (17.6) may be resorted to.

### **15.5.6 Load Tests for Flexural Member**

**15.5.6.1** Load tests should be carried out as soon as possible after expiry of 28 days from the time of placing of concrete.

**15.5.6.2** The structure should be subjected to a load equal to full dead load of the structure plus 1.25 times the imposed load for a period of 24th and then the imposed load shall be removed.

**NOTE-** Dead load includes self weight of the structural members plus weight of finishes and walls or partitions, if any as considered in the design.

**15.5.6.3** The deflection due to imposed load only shall be recorded. If within 24 hrs of removal of the imposed load the structure does not recover at least 75 percent of the deflection under superimposed load, the test may be repeated after a lapse of 72 hrs. If the recovery is less than 80 percent, the structure shall be deemed to be unacceptable.

If the maximum deflection in mm, shown during 24 hrs. under load is less than  $40/2/d$ , where  $f$  is the effective span in m; and  $D$ , the overall depth of the section in mm, it is not necessary for the recovery to be measured and the recovery provisions of 17.6.3 shall not apply.

### **15.5.7 Members Other than Flexural Members**

Members other than flexural members should be preferably investigated by analysis.

**15.5.8** Non-destructive tests are used to obtain estimation of the properties of concrete in the structure. The methods adopted include ultrasonic pulse velocity {see IS 1331} (Part 1) and rebound hammer {IS

1331} (Part 2), probe penetration, pull out and maturity. Non-destructive tests provide alternatives to core tests for estimating the strength of concrete in a structure, or can supplement the at obtained from a limited number of cores. These methods are based on measuring a concrete properly that bears some relationship to strength. The accuracy of these methods, in part, is determined by the degree of correlation between strength and the physical quality measured by the non-destructive tests.

Any of these methods may be adopted, in which case the acceptance criteria shall be agreed upon prior to testing.

**TABLE-11**  
**Characteristic Compressive Strength Compliance Requirement**  
**(Clauses 16.1 and 16.3)**

Specified Grade	Mean of the Group of 4 non-overlapping consecutive tests in N/mm <sup>2</sup>	Individual test Results in N/mm <sup>2</sup>
1	2	3
M 15	$F_{ck} + 0.825 \times \text{established standard deviation}$ (rounded off to nearest 0.5 N/mm <sup>2</sup> ) or $f_k + 3 \text{ N/mm}^2$ whichever is greater	$\geq f_{ck} - 2 \text{ N/mm}^2$
M 20 or above	$F_{ck} + 0.825 \times \text{established standard deviation}$ (rounded off to nearest 0.5 N/mm <sup>2</sup> ) or $f_{ck} + 4 \text{ N/mm}^2$ whichever is greater	$\geq f_{ck} - 3 \text{ N/mm}^2$

**NOTE-** In the absence of established value of standard deviation, the values given in Table 8 may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.

## 16.0 CONCRETE IN ALKALI SOILS AND ALKALINE WATER

Where concrete is liable to attack from alkali salts or alkaline water, special cement containing low amount of tricalcium aluminate shall be used, if so specified on the drawings. Such concrete shall have a minimum 28 days compressive strength of 25 N/mm<sup>2</sup> and shall contain not less than 370 kg. of cement per cubic meter of concrete in place. If specified, additional protection shall be obtained by the use of a chemically resistant stone facing or a layer of Paris covered with suitable fabric, such as jute thoroughly impregnated with tar.

## 17. PREPARATION PRIOR TO CONCRETE PLACEMENT, FINAL INSPECTION AND APPROVAL:

**17.1** Before the concrete is actually placed in position, the insides of the form work shall be inspected to see that they have been cleaned and oiled. Temporary openings shall be provided to facilitate inspection, especially at bottom of columns and wall forms, to permit removal of saw dust, wood shavings, binding wire, rubbish, dirt etc. Openings shall be placed or holes drilled so that these materials and water can be removed easily. Such openings/holes shall be later suitably plugged.

**17.2** The various trades shall be permitted ample time to install drainage and plumbing lines, floor and trench drains, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedments to be case in the concrete as indicated on the drawings or as is necessary for the proper execution of the work. All such embedments shall be correctly positioned and securely held in the forms to prevent displacement during depositing and vibrating of concrete.

**17.3** Slots, openings, holes pockets etc. shall be provided in the concrete work in the positions indicated in the drawings or as directed by Engineer.

**17.4** Reinforcement and other items to be cast in concrete shall have clear surfaces that will not impair bond.

**17.5** Prior to concrete placement all work shall be inspected and approved by Engineer and if found unsatisfactory, concrete shall not be poured until after all defects have been corrected at Contractor's cost.

**17.6** Approval by Engineer of any and all materials and work as required herein shall not relieve contractor from his obligation to produce finished concrete in accordance with the drawings and specifications.

#### **17.7 RAIN OR WASH WATER**

No concrete shall be placed in wet weather or on a water covered surface. Any concrete that has been washed by heavy rains shall be entirely removed, if there is any sign of cement and sand having been washed away from the concrete mixture. To guard against damage which may be caused by rains, the works shall be covered with tarpaulins immediately after the concrete has been placed and compacted before leaving the work unattended. Any water accumulating on the surface of the newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed. To avoid flow of water over/ around freshly placed concrete, suitable drains and sumps shall be provided.

#### **17.8 BONDING MORTAR**

Immediately before concrete placement begins, prepare surfaces except Formwork, which will come in contact with the concrete to be placed, shall be covered with a bonding mortar as specified in paragraph 24.7 of this section.

### **18. TRANSPORTATION**

**18.1** All buckets, containers or conveyers used for transporting concrete shall be mortar-tight. All means of conveyance shall be adapted to deliver concrete of the required consistency and pesticide without segregation or loss of slump whatever method of transportation is employed. Chutes shall not be used for transport of concrete without the written permission of Engineer and concrete shall not be rehandled before placing.

#### **18.2 RETEMPERED OR EQUIPMENT**

Concrete must be placed in its final position before it becomes too stiff to work. On no account, water shall be added after the initial mixing. Concrete which has become stiff or has been contaminated with foreign materials shall be rejected and disposed of as directed by Engineer.

#### **18.3 CLEANING OF EQUIPMENT**

All equipment used for mixing, transporting and placing of concrete shall be maintained in clean condition. All plan. buckets, hoppers, chutes, pipelines and other equipment shall be cleaned after each period of placement.



## **19. PROCEDURE FOR PLACING OF CONCRETE**

### **19.1 ENGINEER'S APPROVAL OF EQUIPMENT & METHODS**

Before any concrete is placed, the entire placing programme consisting of equipment, layout, proposed procedures and methods shall be submitted to Engineer for approval if so demanded by Engineer and no concrete shall be placed until Engineer's approval has been received. Equipment for conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete during depositing without segregation of materials, considering the size of the job and placement location.

### **19.2 TIME INTERVAL BETWEEN MIXING AND PLACING**

Concrete shall be placed in its final position before cement reaches its initial set and concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer and once compacted it shall not be distorted.

### **19.3 AVOIDING SEGREGATION**

Concrete shall, in all cases be deposited as nearly as practicable directly in its final position, and shall not be rehandled or caused to flow in a manner which will cause segregant, loss of materials, displacement of reinforcement, shuttering or embedded inserts or impair its strength. For locations where direct placement is not possible and in narrow forms, contractor shall provide suitable drop and "Elephant Trunks" to confine the movement of concrete. Special care shall be taken when concrete is dropped from a height, especially if reinforcement is in the way particularly in columns and thin walls.

### **19.4 PLACING BY MANUAL LABOUR**

Except when otherwise approved by Engineer, concrete shall be placed in the shuttering by shovels or other approved implements and shall not be dropped from a height more than 1.0 M or handled in a manner which will cause segregation.

### **19.5 PLACING BY MECHANICAL EQUIPMENT**

**19.5.1** The following specification shall apply when placing of concrete by use of mechanical equipment is specifically called for while inviting bids or is warranted considering the nature of work involved.

The control of placing shall begin at the mixer discharge, concrete shall be discharged by a vertical drop into the middle of the bucket or hopper and this principal of a vertical discharge of concrete shall be adhered to throughout all stages of delivery until the concrete comes to rest in its final position.

#### **19.5.2 TYPE OF BUCKETS.**

Central-bottom-dump buckets of a type that provides for positive regulation of the amount and rate of deposition of concrete in all dumping position, shall be employed.

#### **19.5.3 OPERATION OF BUCKET**

In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall clear the concrete already in place and the height of drop shall not exceed 1.00 M. The bucket shall be opened slowly to avoid high vertical bounce. Damping of buckets on the swing or in any manner which results in separation of ingredients or disturbance of previously placed concrete will not be permitted.

### **19.6 PLACEMENT IN RESTRICTED FORMS**

Concrete placed in restrict I forms by barrows, buggies, care, short chutes or hand shovelling shall be subject to the requirement for vertical delivery of limited height to avoid segregation and shall be deposited as nearly as practicable in its final position.

## **19.7 CHUTING**

Where it is necessary to use transfer chutes, specific approval of Engineer must be obtained to type, length, slopes, baffles, vertical terminals and timing of operations. These shall be so arranged that an almost continuous flow of concrete is obtained at the discharge and without segregation. To allow for the loss of mortar against the sides of the chutes, the first mixes shall have less coarse aggregate. During cleaning of chutes, the waste water shall be kept clear of the forms. Concrete shall not be permitted to fall from the end of the chutes by more than 1.0.M. Chutes, when approved for use, shall have slopes not flatter than 1 vert. : 3 horiz. and not steeper than 1 ver.: 2 horiz. Chats shall be of metal or metal lined and of rounded cross section. The slopes of all chute sections shall be approximately the same. The discharge and of the chutes shall be maintained above the surface of the concrete in the forms.

## **19.8 PLACING BY PUMPING/PNEUMATIC PLACES**

**19.8.1** Concrete may be conveyed and placed by mechanically operated equipment e.g. pumps or pneumatic placers only with the written permission of Engineer. The slump shall be held to the minimum, necessary for conveying concrete by this method.

**19.8.2** When pumping is adopted, before pumping of concrete is started, the pipeline shall be lubricated with one or two batches of mortar composed of one part cement and two parts sand. The concrete mix shall be specially designed in suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

**19.8.3** When pneumatic placer is used, the manufactures advice on layout of pipeline shall be followed to avoid blockages and excessive wear. Restraint shall be provided at the discharge box to cater for the reaction at this end. •

Manufacturer's advice shall be followed regarding concrete quality and all other related matters when pumping/pneumatic placing equipment are used.

## **19.9 CONCRETE IN LAYERS**

Concreting, once started, shall be continuous until the pour is completed. Concrete shall be placed in successive horizontal layers of uniform thickness ranging from 15 to 90 cm as directed by Engineer. These shall be placed as rapidly practicable to prevent the formation of cold joints or planes of weakness between each succeeding layer within the pour. The thickness of each layer shall be such that it can be deposited before the previous layer has stiffened. The bucket loads or other units of deposit, shall be spotted progressively along the face of the layer with such overlap as will facilities spreading the layer to uniform depth and texture with a minimum of shrivelling. Any tendency to segregation shall be corrected by shovelling, stones into mortar rather than mortar on to stones. Such a condition shall be corrected by redesign of mix or other means, as directed by Engineer.

## **19.10 BEDDING OF LAYERS**

The top surface of each pour and bedding planes shall be approximately horizontal unless otherwise instructed.

## **19.11 COMPACTION**

Concrete shall be compacted during placing, with approved vibrating equipment until the concrete has been consolidated to the maximum practicable density, is free of pockets of coarse aggregate and fits tightly against all form surfaces, reinforcement and embedded fixtures. Particular

care shall be taken to ensure that all concrete placed against the form faces and into corners of forms or against hardened concrete at joints is free from voids or cavities. The use of vibrators shall be consistent with the concrete mix and caution exercised not to over-vibrate the concrete to the point that segregation results.

#### **19.11.1 Type of vibrators**

Vibrators shall conform to IS specifications. Type of vibrator to be used shall depend on the structure where concrete is to be placed. Shutter vibrators, to be effective, shall be firmly secured to the form work which must be sufficiently rigid to transmit the vibration and strong enough not to be damaged by it. Immersion vibrators shall have "no load" frequency, amplitude and acceleration as per I.S.; 2505 depending on the size of the vibrator. Immersion vibrators in sufficient numbers and each of adequate size shall be used to properly consolidate all concrete. Tapping or external vibrating of frames by hand tools or immersion vibrators will not be permitted.

#### **19.11.2 Use of vibrators**

The exact manner of application and the most suitable machines for the purpose must be carefully considered and operated by experienced men. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn very slowly. In no case shall immersion vibrators be used to transport concrete inside the forms. Particular attention shall be paid to vibration at the top of a lift e.g. in a column or wall.

#### **19.11.3 Melding Successive Batches.**

When placing concrete in layers, which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, blending and melding of the concrete between the succeeding layers.

#### **19.11.4 Penetration of vibrator**

The immersion vibrator shall penetrate the layer being placed and also penetrate the layer below while the under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

#### **19.11.5 Vibrating Against Reinforcement**

Care shall be taken to prevent contact of immersion vibrators against reinforcement steel. Immersion vibrators shall not be allowed to come in contact with reinforcement steel after start of initial set. They shall also not be allowed to come in contact with forms or finished surfaces.

#### **19.11.6 Use of form Attached Vibrators.**

Form attached vibrators shall be used only with specific authorisation of Engineer.

#### **19.11.7 Use of surface vibrators**

The use of surface vibrators will not be permitted under normal conditions. However for thin slabs such as highways, runways and similar construction, surface vibration by specially designed vibrators may be permitted, upon approval of Engineer.

#### **19.11.8 stone pockets and Mortar Pondages**

Formation of stone pockets or mortar pondages in corner and against faces of forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for through bonding, as directed by Engineer.

## **19.12 PLACEMENT INTERVAL**

Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete and before the start of a subsequent placement.

## **19.13 SPECIAL PROVISION IN PLACING**

When placing concrete in walls with openings, in floors of integral slab and beam construction and other similar conditions, the placing shall stop when the concrete reaches the top of the opening in walls or bottom horizontal surface of the slab, as the case may be, placing shall be resumed before the concrete in place takes initial set, but not until it has had time to settle as determined by Engineer.

## **19.14 PLACING CONCRETE THROUGH REINFORCING STEEL**

When placing concrete through reinforcing steel, care shall be taken to prevent segregation of the coarse aggregates. Where the congestion of steel makes placing difficult. It may be necessary to temporarily move the top steel aside to get proper placement and restore reinforcing steel to design position.

## **19.15 BLEEDING**

Bleeding or free water on top of concrete being deposited into the forms, shall be cause to stop the concrete pour and the conditions causing this defect corrected before any further concreting is resumed.

## **20. CONSTRUCTION JOINTS AND KEYS**

**20.1** Concrete shall be placed without interruption until completion of the part of the work between predetermined construction joints as specified hereinafter. Time lapse between the pouring of adjoining units shall be as specified on the drawings or as directed by Engineer.

**20.2** If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be where the work is stopped. Joints shall be either vertical or horizontal, unless shown otherwise on drawings. In case of an inclined or curved member, the joint shall be at right angles to the axis of the member. Vertical joints in walls shall be kept to a minimum. Vertical joints shall be formed against a stop board horizontal joints shall be level and wherever possible, arranged so that the joint lines coincide with architectural features of the finished work. Battens shall be nailed to the Formwork to ensure a horizontal line and. If directed shall also be used to form a grooved joint. For tank walls and similar work joints shall be formed as per IS : 3370. Concrete that is in the process of setting shall not be disturbed or shaken by traffic either on the concrete itself or upon the shuttering. Horizontal and vertical construction joints and shear keys shall be located and shall conform in detail to the requirements of the plans unless otherwise directed by Engineer. Where not described, the joints shall be in accordance with the following ;

### **20.2.1. Column Joint.**

In a column, the joint shall be formed 75 mm below the lowest soffit of the beams including haunches if any. In flat slab construction, the joint shall be 75 mm below the soffit of column capital. At least 2 hours shall elapse after depositing concrete in columns, piers or walls, before depositing in beams, girders or slabs supported thereon.

### **20.2.2 Beam and slab joints**

Concrete in a beam shall be placed throughout without a joint but if the provision of a joint is unavoidable the joint shall be vertical and at the centre or within the middle third of the span unless otherwise as shown in drawings. Where a beam intersects a girder, the joints in the girder shall be offset

a distance equal to twice the width of the beam and additional reinforcement provided for sheer. The joints shall be vertical throughout the full thickness of the concrete member. A joint in a slab shall be vertical and parallel to the principal reinforcement. Where it is unavoidably at right angles to the Principal reinforcement, the joint shall be vertical and at the middle of the span.

### **20.2.3. Joints in Liquid Retaining Structures.**

Vertical construction joints in watertight construction will not be permitted unless indicated on the drawings. Where a horizontal construction joint is required to resist water pressure, special care shall be taken in all phases of its construction to ensure maximum water-tightness.

### **20.2.4 Dowels**

Dowels for concrete work, no likely to be taken up in the near future, shall be wrapped in tar paper and burlap.

### **20.2.5 Mass Foundations**

Mass foundations shall be poured in lifts not exceeding 1.5M, in height unless otherwise indicated on the drawings or approved by the Engineer.

## **21.0 TREATMENT OF CONSTRUCTION JOINTS OR RESUMING CONCRETING**

A direct mix shall be used for the top lift of horizontal pours to avoid laitance. All laitance and loose stones shall be thoroughly and carefully removed by wire brushing/hacking and surface washed.

Just before concreting is resumed, the roughened joint surface shall be thoroughly cleaned and loose matter removed and then treated with a thin layer of cement grout of proportion specified by Engineer worked well into the surface. The new concrete shall be well worked against the prepared face before the grout mortar sets. Special care shall be taken to obtain the rough compaction to avoid segregation of the concrete along the joint plane.

## **22.0 CURING, PROTECTING, REPAIRING AND FINISHING :**

### **22.1 CURING :**

**22.1.1** All concrete shall be cured by keeping it continuously damp for the period of time required for complete hydration and hardening to take place. Preference shall be given to use of continuous sprays, or ponded water, continuously saturated coverings of sacking, canvas, Hessian or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth even-textured coat. Extra precautions shall be exercised in curing concrete during cold and hot weather as outlined hereinafter. The quality of curing water shall be the same as that used for mixing concrete.

**22.1.2** Certain types of finish of preparation for overlaying concrete must be done at certain stages of the curing process and special treatment may be required for specific concrete surface finish.

**22.1.3** Curing of concrete made of high aluminium cement and supersulphated cement shall be carried out as directed by the Engineer.

### **22.1.4 Curing with water**

Fresh concrete shall be kept continuously wet for a minimum period of 10 days from the date of placing of concrete, following a lapse of 12 to 24 hours after laying concrete. The curing of horizontal surfaces exposed to the drying winds shall however begin immediately the concrete has hardened. Water shall be applied to unformed concrete surfaces within 1 hour after concrete has set. Water shall be applied to formed surfaces immediately upon removal of forms. Quantity of water applied shall be controlled so as prevent erosion of freshly placed concrete.

### **22.1.5 Continuous Spraying**

Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliance of hose, sprinklers and spraying devices. Continuous fine mist spraying or sprinkling shall be used unless otherwise specified or approved by Engineer.

### **22.1.6 Alternate curing methods**

Whenever, in the judgment of Engineer, it may be necessary to omit the continuous spray method, a covering of clean sand or other approved means such as wet gunny bags which will prevent loss of moisture from the concrete, may be used. No type of covering will be approved which would stain or damage the concrete during or after the curing period. Covering shall be kept continuously wet during the curing period.

**22.1.7** For curing, if concrete in pavements, side-walks, floors, flat roofs or other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by Engineer. Special attention shall be given to edges and corners of the slabs to ensure proper protection to these areas. The ponded areas shall be kept continuously filled with water during the Curing period.

### **22.1.8 Curing compounds**

Surface coating type curing compounds shall be used only by special permission of Engineer. Curing compounds shall be liquid type while pigmented, conforming to U.S. Bureau of Reclamation specification. No curing compound shall be used on surfaces where future blending with concrete, water or acid proof membranes or painting is specified.

### **22.1.9 Curing Equipment**

All equipment and materials required for curing shall be on hand and ready for use before concrete is placed.

## **22.2 PROTECTION FRESH CONCRETE**

Fresh concrete shall be protected from the elements, from defacements and damages due to construction operations by leaving forms in place for an ample period as specified later in this specification. Newly placed concrete shall be protected by approved means such as tarpaulins from rain, sun and winds. Steps 89 approved by Engineer shall also be taken to protect fresh concrete from damage by debris, excessive loading, vibration, abrasion or contact with other materials etc., that may impair the strength and/or durability of the concrete. Workmen shall be warned against and prevented from disturbing green concrete during its setting period. If it is necessary that workmen enter the area of freshly placed concrete. Engineer may require that bridges be placed over the area.

## **22.3 REPAIR AND REPLACEMENT OF UNSATISFACTORY CONCRETE :**

**22.3.1** Immediately the shuttering is removed, the surface of concrete shall be very carefully gone over and all defective areas called to the attention of Engineer, who may permit patching of defective areas or else reject the concrete unit either partially or in its entirety. Rejected concrete shall be removed and replaced by contractor at no additional expense to department. Holes left by form bolts etc. Shall be filled up and made good with mortar composed of one part of cement to one and half parts of sand passing 2.36 mm I.D. sieve after removing any loose adhering to the concrete. Mortar filling shall be struck off flush at the face of the concrete. Concrete surfaces shall be finished as described under the particular items of work.

**22.3.2** Superficial honeycombed surfaces and rough patches shall be similarly made good immediately after removal of shuttering, in the presence of Engineer and superficial water and air holes shall be filled in. The mortar shall be well worked into the surface with a wooden float. Excess water shall be avoided. Unless instructed otherwise by Engineer the surface of the exposed concrete placed against shuttering shall be rubbed down immediately on removal of shuttering to remove fins or other irregularities, care being taken to avoid damaging the surface. Surface irregularities shall be removed by grinding.

**22.3.3** If reinforcement is exposed or the honey combing occurs at vulnerable positions e.g. ends of beams or columns, it may be necessary to cut out the member completely or in part and reconstruct. The decision of Engineer shall be final in this regard. If only patching is necessary, the defective concrete shall be cut out till solid concrete is reached (or to a minimum depth of 25 mm) the edges being cut perpendicular to the affected surface or with a small under cut if possible. Anchors, tees or dovetails slots shall be provided whenever necessary to attach the new concrete securely in place. An area extending several centimeters beyond the edges and the surfaces of the prepared voids shall be saturated with water for 24 hours immediately before the patching material is placed.

#### **22.3.4 Use of Epoxy**

The use of epoxy for binding fresh concrete used for repairs will be permitted upon written approval of Engineer. Epoxies shall be applied in strict accordance with the instructions of the manufacturer.

#### **22.3.5 Method of Repair**

Small size holes having surface dimensions about equal to the depth of the hole, holes left after removal of form bolts, grout insert holes and slots out for repair of cracks shall be repaired as follows. The holes to be patched shall be roughened and thoroughly soaked with clean water until absorption stops.

A 5 mm thick layer of grout of equal parts of cement and sand shall be well brushed into the surface to be patched, followed immediately by the patching concrete which shall be well consolidated with a wooden float and left slightly proud of the surrounding surface. The concrete patch shall be build up in 10 mm thick layers. After an hour or more, depending upon weather conditions, it shall be worked off flush with a wooden float and a smooth finish obtained by wiping with hessian. A steel trowel shall not be used for this purpose. The mix for patching shall be of the same materials and in the same proportions as that used in the concrete being repaired, although some reducing in the maximum size of the coarse aggregates may be necessary and the mix shall be kept as dry as possible.

Mortar filling by air pressure (guniting) shall be used for repair of areas too large and/or too shallow for patching with mortar. Patched surfaces shall be given a final treatment to match the colour. Patched surfaces shall be given a final treatment to match the colour and texture of the surrounding concrete. White cement shall be substituted for ordinary cement, if so directed by Engineer, to match the shade of the patch into the original concrete.

#### **22.3.6 Curing of Patched work.**

The patched area shall be covered immediately with approved non-staining water-saturated material such as gunny bags which shall be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter, the patched area shall be kept wet continuously by a fine spray or sprinkling for not less than 10 days

#### **22.3.7 Approval by Engineer-in-charge**

All materials, procedures and operations used in the repair of concrete and also the finished repair work shall be subject to the approval of Engineer-in-charge. All fillings shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the fillings have been dried.

## **22.4 FINISHING**

This specification is intended to cover the treatment of concrete surfaces of all structures. Areas requiring special finish not covered by this specification shall be clearly indicated on the drawings and special specifications shall be furnished.

### **22.4.1 Finish for Formed surfaces**

The type of finish for formed concrete surfaces shall be as follows, unless otherwise specified by Engineer.

For surfaces against which backfill or concrete is to be placed, no treatment is required except repair of defective areas.

For surfaces below grade which will receive waterproofing treatment the concrete shall be free of surface irregularities which would interface with proper application of the waterproofing material which is specified for use.

Unless specified surfaces which will be exposed when the structure is in service shall receive no special finish, except repair of damaged or defective concrete, removal of tins and abrupt irregularities, filling of holes left by form ties and rods and clean-up of loose or adhering debris.

**22.4.2** Surfaces which will be exposed to the weather and which would normally be level, shall be sloped for drainage. Unless the drawing specifies a horizontal surface or shows the slope required. The tops of narrow surfaces such as stair treads, walls, curbs and parapets shall be sloped across the width approximately 1 in 30. Broader surfaces such as walkways, roads, parking areas and platform shall be sloped about 1 in 50. Surfaces that will be covered by backfill or concrete, sub-floors to be covered with concrete topping, terrazzo or quarry tile and similar surfaces shall be smooth, screened and levelled to produce even surfaces. Surface irregularities shall not exceed 6 mm. Surfaces which will not be covered by backfill concrete or tile topping such as outside decks, floors of galleries and slumps, parapets, gutters, sidewalks, floors and slabs, shall be consolidated, screeded and floated. Excess water & laitance shall be removed before final finishing. Floating may be done with hand or power tools and started as soon as the screeded surface has attained a stiffness to permit finishing operations and these shall be the minimum required to produce a surface uniform to texture and free from screed marks or other imperfections. Joints and edges shall be tooled as called for on the drawings or as directed by the Engineer

### **22.4.3 Standard Finish for Exposed concrete.**

Exposed concrete shall mean any concrete. Other than floor or slabs, exposed to view upon completion of the job.

Unless otherwise specified on the drawings, the standard finish for exposed concrete shall be a smooth finish.

A smooth finish shall be obtained with the use of lined or plywood forms having Smooth and even surfaces and edges. Panels and forms linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms the joint marks shall be smoothed off and all blemishes, projections, etc. removed leaving the surfaces reasonably smooth and unmarred.

### **22.4.4 Integral Cement Concrete Finish**

When specified on the drawings an integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded, as specified on the drawings, as per I.S.: 2571. The surface shall be compacted and then floated with a wood float or power floating machine. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of the finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of



dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.

#### **22.4.5 Rubbed Finish**

A rubbed finish shall be provided only on a exposed concrete surface as specified on the drawings. Upon removal of forms, all fins and other Projections on the surfaces shall be carefully removed, offsets levelled and voids and/or damaged sections immediately saturated with water and repaired by filling with a concrete or mortar of the same compositions as was used in the surface. The surface shall then be thoroughly wetted and rubbed with carborandum or other abrasive. Cement mortar may be used in the rubbing, but the finished surfaces shall not be brush coated with either cement or grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

#### **22.4.6 Protection**

All concrete shall be protected against damage until final acceptance by the Engineer.

### **23. FORMWORK**

**23.1** The Formwork shall consist of shores, bracings, sides of beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts etc. complete which shall be properly designed and planned for the work. False work shall be so constructed that vertical adjustments can be made to compensate for take up the settlements. Wedges may be used at the top or bottom of timber shores, but not at both ends, to facilitate vertical adjustment or dismantling of the Formwork.

#### **23.2 DESIGN OF FORMWORK**

The design and engineering of the work as well as its construction shall be the responsibility of contractor. If so instructed, the drawings and calculations for the design of the Formwork shall be submitted to Engineer for approval before proceeding with work, at no extra cost of the Department. Engineer's approval shall not however relieve Contractor of the full responsibility for the design and construction of the Formwork. The design shall take into account all the loads vertical as well as lateral, that the forms will be carrying including live and vibrations loadings.

#### **23.3 TOLERANCES**

Tolerance is a specified permissible variation from lines, grade or dimensions given in drawings. No tolerances specified for horizontal or vertical building lines or footing shall be construed to permit encroachment beyond the legal boundaries. Unless otherwise specified, the following tolerances will be permitted.

##### **23.3.1. Tolerance for R.C. Buildings**

- i) Variation from the plumb.
  - (a) In the lines and surfaces of columns, piers, walls and in arises 5mm per 2.5m, but not more than 25 mm.
  - (b) For exposed corner columns and other conspicuous lines.

In any bay or 5 m maximum	-	5 mm
In 10 m or more	-	10 mm
- ii) Variation from the level or from the grades indicated on the drawings.
  - (a) In slab soffits, ceilings, beam soffits and in arises

	In 2.5 m	-	5 mm
	In any bay or 5 m maximum	-	8 mm
	In 10 m or more	-	15 mm
(b)	For exposed lintels, sills, parapets, horizontal groves and other conspicuous lines		
	In any bay or 5 m maximum	-	5 mm
	In 10m or more	-	10 mm
(iii)	Variation of the linear building lines from established position in plan & related position of columns, walls & partitions.		
	In any bay or 5 m maximum	-	10 mm
	In 10 m or more	-	20 mm
(iv)	Variation in the sizes and locations of sleeves, openings in walls and floors		
	Except in the case of and for anchor bolts	-	5 mm
(v)	Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls		
	Minus	-	6 mm
	Plus	-	12 mm
(vi)	Footings		
	(a) Variation in dimension in plan		
	Minus	-	12 mm
	Plus	-	50 mm
	(b) Misplacement or eccentricity		
	2% of footing width in the direction of misplacement but not more than 50 mm		
	(c) Reduction in thickness		
	Minus subject	-	5% specified thickness
			to a maximum of 50 mm.
(vii)	Variation in steps		
	(a) In flight of stairs		
	Rise	-	3 mm
	Tread	-	5 mm

### 23.3.2. Tolerances in other concrete structures.

- (a) All Structures
- i) Variation of the constructed linear outline from established position in plan.
- |                |   |       |
|----------------|---|-------|
| In 5 m         | - | 10 mm |
| In 10m or more | - | 15 mm |
- ii) Variations of dimensions to individual structure features from established positions.
- |                        |   |       |
|------------------------|---|-------|
| In 20 m or more        | - | 10 mm |
| In buried construction | - | 50 mm |
- iii) Variation from plumb, from specified better or from curved surfaces of all structures.
- |                        |   |                          |
|------------------------|---|--------------------------|
| In 2.5 m               | - | 10 mm                    |
| In 5 m                 | - | 15 mm                    |
| In 10m or more         | - | 25 mm                    |
| In buried-construction | - | Twice the above amounts. |
- iv) Variation from level or grade indicated on drawings in slabs, beams, soffits, horizontal grooves and visible arises.
- |                        |   |                          |
|------------------------|---|--------------------------|
| In 2.5 m               | - | 5 mm                     |
| In 7.5 m               | - | 10 mm                    |
| In buried construction | - | Twice the above amounts. |
- v) Variation in cross-sectional dimensions of columns, beams buttresses, piers and similar members
- |       |   |       |
|-------|---|-------|
| Minus | - | 5 mm  |
| Plus  | - | 10 mm |
- vi) Variation in the thickness of slabs, walls, arch sections and similar members
- |       |   |       |
|-------|---|-------|
| Minus | - | 5 mm  |
| Plus  | - | 10 mm |
- (b) Footings for columns, piers, walls, buttresses and similar members.
- i) Variation of dimensions in plan
- |       |   |       |
|-------|---|-------|
| Minus | - | 10 mm |
| Plus  | - | 50 mm |
- ii) Misplacement or eccentricity
- 2% of footing width in the direction of Misplacement but not more than 50 mm

iii) Reduction in thickness

5% of specified thickness subject to a max of 50 mm.

**23.3.3** Tolerances in other types of structures shall generally conform to those to those given in Clause 2.4 of Recommended Practice for Concrete Formwork (ACI: 347)

## **23.4 TYPE OF FORMWORK**

Formwork may be of timber, plywood, metal, plastic or concrete. For special finishes the Formwork may be lined with plywood, steel sheets, oil tempered hard board, etc. Sliding forms and slip forms may be used with the approval of Engineer.

## **23.5 FORMWORK REQUIREMENTS**

**23.5.1** Forms shall conform to the shapes, lines grades and dimensions including camber of the concrete as called for on the drawings. Ample studs, waters, braces, ties, straps, shores etc. shall be used to hold the forms in proper position without any distortion whatsoever until the concrete has set sufficiently to permit removal of forms. Forms shall be strong enough to permit the use of immersion vibrators. In special cases form vibrators may also be used. The shuttering shall be close boarded. Timber shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps or other surfacedefects in contact with concrete. Faces coming in contact with the concrete shall be free from adhering grout.plaster, paint, projecting nails, splits or other defects. Joints shall be sufficiently tight to prevent loss of water and fine material from concrete.

**23.5.2** Plywood shall be used for Exposed Concrete surfaces; where called for. Sawn and wrought timber may be used for unexposed surfaces. Inside faces of form for concrete surfaces which are to be rubbed finished shall be planned to remove irregularities or unevenness in the face. Formwork with linings will be permitted.

**23.5.3** All new and used form lumber shall be maintained in good condition with respect to shape, strength, rigidity, water tightness, smoothness and cleanliness of surfaces. Form lumber unsatisfactory in any respect shall not be used and if rejected by Engineer, shall be removed from the site.

**23.5.4** Shores supporting successive stories shall be placed directly over those below or be so designed and placed that the load will be transmitted directly to them. Trussed supports shall be provided for shores that can not be secured on adequate foundations.

**23.5.5** Formwork, during any stage of construction showing signs of distortion of distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the drawings, shall be repositioned and strengthened. Poured concrete affected by the faulty formwork, shall be removed in its entirety and the formwork corrected prior to placing new concrete.

**23.5.6** Excessive construction camber to compensate for shrinkage, settlement, etc. that may impair the structural strength of members will not be permitted.

**23.5.7** Forms for substructure concrete may be omitted when, in the opinion of engineer, the open excavation is firm enough to act as the form. Such excavations shall be slightly larger than required by the drawings to compensate for irregularities in excavation and to ensure the design requirements.

**23.5.8** Forms shall be so designed and constructed that their removal will not damage the concrete. Face formwork shall provide true vertical and horizontal joints, conform to the architectural features of the structure as to location of joints and as directed by Engineer-in-charge.

**23.5.9** Where exposed smooth or rubbed concrete finishes are required the forms shall be constructed with special care so that the resulting concrete surfaces with require a minimum-finish,

### **23.6 BRACINGS, STRUTS AND PROPS**

Shuttering shall be braced, strutted, propped and so, supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials. Bamboos shall not be used as props or cross bearers. The shuttering for beams and slabs shall be so erected that the shuttering on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms.

Repropping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be gently lowered vertically while striking the shuttering.

If the shuttering for a column is erected for the full height of the column, one side shall be left open and built upon sections as placing of concrete proceeds, or windows may be left for pouring concrete from the sides to limit the drop of concrete to 1.0 M or as directed by the Engineer.

### **23.7 MOULD OIL**

Care shall be taken to see that the faces of formwork coming in contact with concrete are perfectly cleaned and two coats of mould oil applied before fixing reinforcement and placing concrete, such coating shall be insoluble in water, non-staining and not injurious to the concrete. It shall not become flaky or be removed by rain or wash water. Reinforcement and/or other items to be cast in the concrete shall not be placed until coating of the forms is complete. Adjoining concrete surfaces shall also be protected against contamination from the coating material.

### **23.8 CHAMBERS AND FILLETS**

All comers and angles exposed in the finished structure shall be formed with mouldings to form chambers or fillets on the finished concrete. The standard dimensions of chambers and fillets, unless otherwise specified, shall be 20 mm X 20 mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaced to the same texture as the forms to which it is attached.

### **23.9 VERTICAL CONSTRUCTION JOINT CHAMFERS**

Vertical construction joints on faces which will be exposed at the completion of the work shall be chamfered as above except where not permitted by Engineer for structural or hydraulic reasons.

### **23.10 TIES FOR BEAMS, WALLS**

Wire ties passing through the walls shall not be affected. Also through bolts shall not be permitted. For fixity of formwork, alternative arrangements such as coil nuts shall be adopted at the contractor's cost.

### **23.11 REUSE OF FORMS**

Before reuse, all forms shall be thoroughly scraped, cleaned, nail removed, holes that may leak suitably plugged and joints examined and when necessary, repaired and the inside retreated to prevent adhesion, to the satisfaction of Engineer, warped lumber shall be resized. Contractor shall equip himself with enough shuttering to complete the job in the stipulated time.

### **23.12 REMOVAL OF FORMS**

**23.12.1** Contractor shall record on the drawing or a special register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed therefrom.

**23.12.2** In no circumstances shall forms be struck until the concrete reaches a strength of at least twice the stress due to self-weight and any construction/erection loading to which the concrete may be subjected at the time of striking formwork.

**23.12.3** In normal circumstances (generally where temperatures are above 20 C) forms may be struck after expiry of the following periods.

	<b>Ordinary Portland Cement Concrete</b>	<b>Rapid Hardening Portland Cement Concrete</b>
a) Walls, columns and vertical sides of beams	24 to 48 hours as directed by EIC	24 hours
b) Slabs (Pros. Left under)	3 days	2 days
c) Beams, Soffits (Props Left Under)	7 days	4 days
d) Removal of props to slab: i. Spanning upto 4.5 mtr ii. Spanning over 4.5 mtr	7 days 14 days	4 days 8 days
e) Removal of props to beams arches i. Spanning upto 6 mtr ii. Spanning over 6 mtr	14 days 21 days	8 days 12 days

**23.12.4** Striking shall be done slowly with utmost care to avoid damage arises and projections and without shock or vibration, by gently easing the wedges. IF after removing the formwork, it is found that timber has been embedded in the concrete, it shall be removed and made good as specified earlier.

**23.12.5** Reinforced temporary openings shall be provided, as directed by Engineer, to facilitate removal of formwork which otherwise may be inaccessible.

**23.12.6** Tie rods, clamps, form bolts etc. which must be entirely removed from walls or similar structures shall be loosened not sooner than 24 hours nor later than 40 hours after the concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same times. Ties withdrawn from walls and grade beams shall be pulled towards the inside face. Cutting ties back from the faces of walls and grade beams will not permitted.

## **24. FORM OIL**

Use of form oil shall not be permitted on the surface which require painting. If the Contractor desires to use form oil on the inside of formwork of other concrete structures a nonstaining mineral oil or other approved oil 'CEMOL-35' of M/s. Hindustan Petroleum Co. Ltd. may be used provided it is applied before placing reinforcing steel and embedded parts. All excess oil on the form surfaces and any oil on metal or other parts to be embedded in the concrete shall be carefully removed. Before treatment with oil, forms shall be thoroughly cleaned of dried splatter of concrete from placement of previous lift.

## **25. FINISHING**

### **25.1 GENERAL**

Unless otherwise specified concrete finished shall conform to the following classifications :

Finish F1, F2 and F3 shall describe formed surfaces.

Finish U1, U2 and U3 shall describe unformed surfaces,

**25.1.1** Offsets or fins caused by displaced or misplaced form sheathing lining or form sections or by defective 1 form lumber shall be referred to as abrupt irregularities. All other irregularities shall be referred to as gradual irregularities. Gradual irregularities shall be measured as deviation from a plane surface with a template 1.5 M long for formed surfaces and 3.0 M long for unformed surfaces.

## **25.2 FORMED SURFACES :**

- Finish F1** : shall apply to all formed surfaces for which finish F2, F3 or any other special finish is not specified.
- Finish F1 : shall include:  
Filling all form tie holes
- Finish F2 : shall apply to all formed surfaces so shown on the drawings or specified by the Engineer
- Finish F2 : shall include : filling all form tie holes, repair of gradual irregularities exceeding 6 mm, removal of redges and fins and abrupt irregularities by grinding.
- Finish F3 : shall apply to all formed surface exposed to view or where shown on the drawings or specified by the Engineer.
- Finish F3 : shall include all measures specified for finishing F2 and in addition, filling air holes with mortar and treatment of the entire surface with sack rubbed finish. It shall also include clean up of loose and adhering debris. Where a sack rubbed finish is specified the surfaces shall be prepared within two days after removal of the forms.

The surfaces shall be wetted and allowed to dry slightly before mortar is applied by sack rubbing. The mortar used shall consist of one part cement to one half parts by volume of fine (minus No. 16 mesh) sand. Only sufficient mixing water to give the mortar a workable consistency shall be used. The mortar shall then be rubbed over the surface with a fine burlap or linen cloth so as to fill all the surface voids. The mortar in the voids shall be allowed to stiffen and solidify after which the whole surface shall be wipe clean with clean burlap such that all air holes etc. are filled and the entire surface presents a uniform appearance without air holes, irregularities etc.

Curing of the surface shall be continued for a period of seven days.

## **25.3 UNFORMED SURFACES**

- Finish U1 - shall apply to all unformed surfaces for which finish U2, U3 or any other special finish is not specified .
- Finish U1 - shall include:  
Screeding the surface of the concrete to the required slopes and grade. Unless . the drawing specified a horizontal surface or shows the slope required, the tops of narrow surfaces, such as stair, treads, walls, curbs and parapets shall be sloped approximately 10 mm per 300 mm width. Surfaces to be covered by back-fill or concrete, sub-floors to be covered with concrete topping, terrazzo, and similar surfaces shall be smooth screeded and levelled to produce even surface irregularities not exceeding 6 mm.

- Finish U2 - shall apply to all unformed surfaces as shown on the drawings or specified by the Engineer.
- Finish U2 - shall include : Screeding and applying a wood float finish to the surface of the concrete to the required slopes and grade.  
Repair of abrupt irregularities exceeding 6 mm.
- Finish U3 - shall apply to all unformed surface for which a high degree of surfaces smoothness is required, where shown on the drawings or specified by the Engineer.
- Finish U3 - shall include :  
Screeding, floating and applying a steel trowel finish to the surface of the concrete to the required slopes and grade; Repair of gradual irregularities exceeding 6 mm, finishing joints and edges of. concrete with edging tools.

## **26. FORMWORK TIE-RODS**

Metal tie-rods shall be used for supporting all forms. Provision shall be made for removal of a section of each rod at surface of the concrete a depth of approximately 50 mm. All holes left by the removal of conical nuts or other removal fixtures embedded in the face of the concrete shall be filled and finished with cement sand mortar in a manner specified in the Section 27 of this specification. Use of internal through ties in the walls shall not be permitted. Threaded inserts embedded on each face of the wall together with precast concrete stepped spacers shall be used for attaching the forms to previously place concrete.

## **27. WATER STOPS**

Only actual lengths after joining (excluding laps) as placed shall be measured.

## **28. FORMWORK**

The measurement for formwork shall be taken as the area of the forms in contact with the concrete surfaces. Formwork for temporary construction joints will also be measured unless such are disapproved by the Engineer. Formwork required for shear keys on horizontal unformed surfaces, formwork if required for grouting etc. shall not be paid for.

Formwork will be measured under the respective categories indicated in the Schedule of Quantities.

When formwork for columns are to be measured separately, the measurement shall be from the top of the footings or bottom of the slab to underside of the upper slab or termination of column or wall as the case may be. Formwork for beams between columns and walls shall be measured clear between faces of columns and walls. Formwork for suspended floors and roofs shall be to the finished .section shown on the drawings and shall include suspended floors and roofs supported on structural steel, walls and columns. The extent of formwork pertaining to various structures will be in accordance with the limit of concrete work shown on the drawings.

The Contractor will be paid for formwork at the rate quoted by him against the Schedule of Quantities. The rate quoted shall be inclusive of formwork also.

## **29. SETTING OF EMBEDDED PARTS**

All embedded parts will be fabricated and supplied by others are by contractor to suite the construction schedule. Embedded parts shall generally consist of and bolts (without pipe sleeves).



Anchor bolts (with pipe sleeves), structural shafts, plates, electrical inserts, pipe sleeves, box shape, electrical conduits, roof drains and floor drains and the piping, flushing, angles with lugs, any type of structural steel parts etc. which are required to be embedded monolithically either wholly or partly, in concrete structures but shall not include reinforcing steel, form ties etc. The contractor shall ensure that the embedded parts are clean and any contamination such as mud, oil paint, laitance, rust, mill scale, all other foreign substances etc. shall be removed before fixing them in position. Angle frames required for pipe and cable trenches inside various buildings such as Refrigeration plant. Central control room, substation etc. and other structural shapes as required shall be fabricated by the contractor as shown in the drawing and as directed by the Engineer. The contractor shall leave all openings, pockets, grooves, chases etc. in concrete as shown on drawings.

Embedded parts shall be accurately placed in the position shown on the drawing and shall be firmly held during the placing and setting of concrete. Templates shall be used for aligning and securing all the embedded parts as specified by the Engineer or shown on the drawings. In the case of partial embedments, the length projecting from the concrete shall be protected from damage and build up of rust. The contractor shall take utmost care and protect the projecting threads of the anchor bolts.

Unless otherwise specified, form ties, reinforcing steel concrete platforms, runways and the like shall not be attached in any way to embedded parts.

Vibrator shall not come in contact with embedded parts during the placing of concrete and embedded parts shall be free from undue vibration from other operations of the Contractor.

Except as noted hereunder or specified in the drawings or as directed by the Engineer, all embedded parts shall be set to a tolerance of  $\pm 3$  mm.

Surfaces of embedded parts which concrete shall be left unpainted. Other all exposed surfaces shall be cleaned thoroughly of oil, mill scale, rust and other foreign matter and shall be painted with one shop coat of red lead primer conforming to IS: 102.

### **30. CONSTRUCTION JOINTS**

The rates for providing construction joints shall be included in the concrete items themselves.

#### **30.1 PREPARATION OF EARTH STRATA OF FOUNDATIONS**

All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft yielding soil shall be removed and replaced with suitable earth and well compacted as directed by Engineer. Where specified, lean concrete shall be provided on the earth stratum for receiving concrete. The surface of absorptive soils against which concrete is to be placed shall be moistened thoroughly so that no moisture will be drawn from the freshly placed concrete and later shall help to cure the concrete.

#### **30.2 PREPARATION OF CONCRETE SURFACES**

The preparation of concrete surfaces upon which additional concrete is to be placed later shall preferable be done by scraping and cleaning while the concrete is between its initial and final set. This method shall be used wherever practicable and shall consist of cutting the surface with pickets and stiff brooms and by use of an approved combination of air and water jet as directed by Engineer. Great care shall be taken in performing this work to avoid removal of too much mortar and the weakening of the surface by loosening of aggregate.

When it is not practicable to follow the above method, it will be necessary to employ air tools to remove laitance and roughen the surface.

The final required result shall be a pitted surface from which all dirt, unsound concrete, laitance and glazed mortar have been removed.

### **31. BONDING TREATMENT (MORTAR)**

After rock or concrete surfaces upon which new concrete is to be placed have been scarified, cleaned and wetted as specified herein they shall receive a bonding treatment immediately before placement of the concrete.

**31.1** The bonding medium shall be a coat of cement-sand mortar. The mortar shall have the same cement-sand proportions as the concrete which shall be placed on it. The water-cement ratio shall be determined by placing conditions and as approved by Engineer.

**31.2** Bonding mortar shall be placed in sufficient quantity to completely cover the surface about 10 mm thick for rock surface and about 5 mm thick for concrete surfaces. It shall be brushed or broomed over the surface and worked thoroughly into all cracks crevices and depressions. Accumulations or puddles of mortar shall not be allowed to settle in depressions and shall be brushed out to a satisfactory degree as determined by Engineer.

**31.3** Mortar shall be placed at such a rate that it can be brushed over the surface just in advance of placement of concrete. Only as much area shall be covered with mortar takes place. The amount of mortar that will be permitted to be placed at any one time, or the area which it is to cover, shall be in accordance with Engineer.

### **31.4 CLEANING AND BONDING FORMED CONSTRUCTION JOINTS**

Vertical construction joints shall be cleaned as specified above or by other methods approval by Engineer. In placing concrete against formed construction joints, the surface of the joints, where accessible shall be coated thoroughly with the specified bed joint bonding mortar immediately before they are covered with concrete or by scrubbing with wire brooms dipped into the fresh concrete. Where it is impracticable to apply such a mortar coating special precautions shall be taken to ensure that the new concrete is brought into intimate ' contact with the surface of the joint by careful ponding and spading with aid of vibrators and suitable tools.

### **32. HOT WEATHER REQUIREMENTS**

**32.1** All concrete work performed in hot weather shall be in accordance with I.S.: 456 except as herein modified.

**32.2** Admixtures may be used only when approved by Engineer, and paid extra.

**32.3** Adequate provisions shall be made to lower concrete temperatures by cool ingredients, eliminating excessive mixing, preventing exposure of mixers and conveyers to direct sunlight and the use of reflective paint on mixers etc.

**32.4** Consideration shall be given to shading aggregate stockpiles from direct rays of the sun and spraying stockpiles with water, use of cold water when available, and burying, insulating, shading and/or painting white the pipe lines and water storage tanks and conveyance.

**32.5** In order to reduce loss of mixing water, the aggregates, wooden forms, subgrade, adjacent concrete and other moisture absorbing surfaces shall be well wetted prior to concreting. Placement and finishing shall be done as quickly as possible.

**32.6** Extra precautions shall be taken for the protection and curing of concrete. Consideration shall be given to continuous water curing and protection against high temperatures and drying hot winds for a period of at least 7 days immediately after concrete has set and after which normal curing procedures may be resumed.

### **33. PLACING CONCRETE UNDERWATER**

**33.1** Under all ordinary conditions all foundations shall be completely dewatered and concrete placed in the dry. However, when concrete placement under water is necessary shall be as follows.

**33.2 METHOD OF PLACEMENT**

Concrete shall be deposited underwater by means of tremiese, or drop bottom buckets of approved type

**33.3 DIRECTION, INSPECTION AND APPROVAL**

All work requiring placement of concrete underwater shall be designed, directed and inspected with the regard to local circumstances and purposes. All underwater concrete shall be placed according to the plans or specifications and as directed and approved by the Engineer.

**34. SLOTS, OPENINGS ETC.**

Slots, openings or holes, pockets etc., shall be provided in the concrete work in the position indicated in the drawings or as directed by Engineer. Any deviation from the approved drawings shall be made good by Contractor at his own expense, without damaging any other work. Sleeves, bolts, inserts, etc. shall also be provided in concrete work where so specified.

**35. PAYMENT**

**35.1** The unit rate for concrete work under various categories shall be all inclusive and no claims for extra payment on account of such item as leaving holes, pockets, embedding inserts etc. Shall be entertained unless separately provided for in the schedule of quantities, NO extra claim shall also be entertained due to change in the number, position and/or dimensions of holes, slots or openings, sleeves, inserts or on account of any increased lift or scaffolding etc. All these factors should be taken into consideration while quoting the unit rates. Unless provided for in the Schedule of quantities the rates shall also include fixing inserts in all concrete work, whenever required.

**35.2** Payments of concrete will be made on the basis of unit rates quoted for the respective items in the schedule of quantities. No deduction in the concrete quantity will be made for reinforcements, inserts etc. and opening less than 1/20 of a sq. m. in area where concrete is measured in sq. m. and 1/50 mm. where concrete is measured in Cum. Where no such deduction for concrete is made, payment for shuttering work provided for such holes, pockets etc. will not be made. Similarly, the unit rate for concrete work shall be inclusive or exclusive of shuttering as provided for in the Schedule of Quantities. Where formwork is paid for separately, it shall be very clearly understood that payment for formwork is inclusive of formwork, shuttering, shoring, propping, scaffolding etc., complete.

**35.3** Payment for beams will be made for the quantity based on the depth being reckoned from the underside of the slabs and length measured as the clear distance between supports. Payment for columns shall be made for the quantity based on height reckoned upto the underside of slabs.

# **PART -D**

## **ARCHITECTURAL ITEMS**

### **1. BRICK WORK:**

#### **1.1 BRICKS**

Bricks shall be of uniform size, shape, sound, hard, homogeneous in texture and colour must be well burnt so as to give a clear ringing sound when struck. They shall be clean, whole and free from flaws, chips, cracks, stones or lumps of any kind, especially lime. They shall not show any signs of efflorescence either dry or subsequent to soaking in water. They shall have sharp edges and angles and even surfaces and shall be sound and hard to resist compression. They shall be from a source to be approved by the Engineer and shall conform to IS : 1077-1986. Bricks shall be of uniform deep red, cherry or copper colour, thoroughly and uniformly burnt, without being vitrified, regular in shape and size and shall have sharp and square sides, edges and parallel faces to ensure uniformity in the thickness of the courses of brickwork.

The size of brick shall be size 200 X 100 X 100 mm. Dimension tolerance will be 400 cm  $\pm$ 8cm for length, 200 cm $\pm$ 4cm for breadth and 200 cm $\pm$ 4cm for height when 20 bricks assembled and measured at a time as per the procedure laid down in IS: 1077-1986. The crushing strength of bricks should not be less than 50 kg./ square cm. and acceptance criteria will be as per IS : 1077-1986. The crushing strength of any individual brick tested shall not fall below the minimum average compressive strength specified for the corresponding class of brick by more than 20%.

Bricks shall be provided with frogs. Only full size brick shall be used for masonry work. Brick bats shall be used only with the permission of the Engineer to make-up required wall strength or for bonding. Representative sample bricks to be used shall be submitted to the Engineer for approval before making bulk purchase and all bricks used on the work shall conform to these approved samples in all respects. Brick samples shall be tested as required by Engineer at Departmental lab. by the owner. The contractor will have to make arrangements for transportation to the lab. Bricks rejected by Engineer shall be removed from the site of work within 24 hours. Bricks shall be stacked in approved manner. Each stacks shall contain nearly equal number of bricks preferably not more than 3000.

##### **1.1.1 Water Absorption**

The bricks when tested in accordance with the procedure laid down in IS: 3495 (Part-2)-1976, after immersion in cold water for 24 hours, the average water absorption shall not be more than 20% by weight.

#### **1.2 WATER, CEMENT AND SAND**

Water, cement and sand shall conform to the specifications as given in Section V-C i.e. specifications for plain RCC and precast concrete and allied works.

#### **1.3 MORTAR**

Mortar for brick masonry shall be prepared as per IS : 2250. Mix for cement mortar shall be as specified in the respective items of work. Gauge boxes for sand shall be of such dimensions that one complete bag of cement containing 50 kgs. of cement forms on unit. The sand shall be free from clay, shale, loam, alkali and organic matter shall be of sound, hard, clean and durable particles. Sand shall be approved by the Engineer. If so directed by the Engineer, sand shall be thoroughly washed till it is free of any contamination.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement

mortar shall preferably be machine mixed, though hand mixing in a thorough manner may be allowed. The mortar so mixed shall be used within 25 minutes of mixing. Mortar left unused beyond specified period shall be rejected.

The contractor shall arrange for test on mortar samples if so directed by the Engineer. Repairing/ remixing of mortar shall not be permitted.

#### **1.4 WORKMANSHIP**

**1.4.1** All bricks shall be thoroughly soaked in clean water for at least six hours immediately before being laid. The contractor shall provide tanks of adequate capacity to allow for the required soaking period. Bricks shall be laid in water and not thrown abruptly. The bricks shall not be too wet at the time of use, as they are likely to slip on the mortar bed, and there may be difficulty in ensuring plumbness of the wall.

The cement mortar for brick masonry shall be as specified in the respective item of work. Brick work 200 mm thick and over shall be laid in English Bond unless otherwise specified. 100 mm thick brick work shall be laid with stretchers. For laying bricks a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Brick shall be laid with frogs uppermost.

**1.4.2** Before starting the brick masonry, the concrete surfaces e.g. plinth beams, columns, slabs, chajjas etc. shall be thoroughly hacked and washed to remove all mud, dirt, loose particles etc. and a thin coat of cement slurry shall be applied over concrete surfaces. When the fresh masonry is to be started on or against old masonry, the surface of the old masonry should be thoroughly cleaned and washed to remove all mass deposits, loose mortar, mud and dirt etc.

**1.4.3** All brickwork shall be plumb, square and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall be kept uniform. For walls of thickness greater than 200mm both faces shall be kept in vertical planes. All interconnected brickwork shall be carried out at nearly one level (so that there is uniform distribution of pressure on the supporting structure) and no portion of the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 45 Degree. But in no case the level difference between adjoining walls shall exceed 1.00 M. Work shall not be raised more than 12 courses in a single day. Workmanship shall conform to IS : 2212.

**1.4.4** Bricks shall be so laid that all joints are well filled with mortars. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 12mm by raking tools daily during the progress of work when the mortar is still green, so as to provide a proper key for the plaster or pointing to be done. When plastering or pointing is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. If the mortar in the lower course has begun to set, the joints shall be raked out to a depth of 12 mm before another course is laid.

**1.4.5** 100 mm brick work shall be carried out in panels and with horizontal stiffeners as well as vertical stiffeners of size 100 mm x 100 mm at every 900 mm maximum spacing or as indicated in drawing and as specified in item with 2 nos. 8 dia. bars longitudinally, 8 dia. cross ties @ 150 c/c laid in 1:2:4 concrete properly filled as per specifications brick work shall be built tightly against columns, floor slabs or other structural members.

Brick work shall be kept moist for a minimum period often days or more, as directed by Engineer.

**1.4.6** Miscellaneous inserts in masonry e.g. sleeves, wall ties, anchors, conduits, structural steel, lintels etc. shall be installed by the contractor. Openings etc. shall be provided as shown in the drawings.

Chases, pockets, etc. shall be provided as shown in the drawings to receive windows, louvers, door frames, circular openings for exhaust fans etc. In case conduits junction boxes for electrical works are installed by the other agency prior to construction of brickwork maintaining the alignment of these during masonry and plastering shall be the responsibility of the main civil contractors. Wall ties and flashiness shall be built into the brickwork in accordance with the drawings and specifications. It shall be clearly understood that the rates quoted by the contractor include leaving openings in brickwork for various trades etc.

## **1.5 MEASUREMENT**

Brickwork of thickness one brick i.e. 230/200 mm and above shall, unless otherwise stated in the schedule of quantities, be paid in units of cum or part thereof. Brickwork of thickness less than one brick i.e. less than 230/200 mm thick shall be measured and paid on the basis of rates quoted per sq.m. or part thereof. In case of brick masonry 105/100 mm thick, the rate shall be inclusive of the cost of R.C. stiffeners only. M.S./ HYSD/TMT reinforcement, however, will be measured and paid separately. In all cases, the quantities measured and paid for shall be those actually executed after making necessary deductions for all openings etc. Brick masonry for steps and such other mass works and encasement shall be paid per Cum. or part thereof. No deduction shall be made for opening up to 0.10 m<sup>2</sup> in area.

## **2. RANDOM RUBBLE MASONRY, UNCOURSED, IN FOUNDATION, PLINTH AND SUPERSTRUCTURE :**

**2.1** Stones for this work shall be hard, durable, rock, close and fine grained and uniform in colour, free from veins, flaws and other defects and shall conform to IS: 1597 (Part I). The stones shall be laid in mortar proportions specified for the particular item of work. Stones shall be got approved by Engineer. Discoloured or distorted stones with boulders skin or earthy or porous matter, or stones with round surface shall have crushing strength not less than 150 Kg/cm<sup>2</sup>. Stones shall be properly cleaned of oil, dirt and dust and all weathered portions shall be removed completely before having a use.

The stones shall be hammer dressed on the face, the sides and bed to enable them to come in contact with each other. The stones may be laid at random without being brought upto any level course as directed by Engineer.

**2.2** Before starting the rubble masonry, the concrete surfaces e.g. plinth beams, columns, slabs, chajjas etc. shall be thoroughly hacked and washed to remove all mud, dirt, loose particles etc. and a thin coat of cement slurry shall be applied over concrete surfaces. When the fresh masonry is to be started on or against old masonry, the surface of the old masonry should be thoroughly cleaned and washed to remove all mass deposits, loose, mortar, mud and dirt etc.

**2.3** All stones shall be thoroughly wetted before use. Work shall be carried out true to plumb. Excavated portion of the wall footing over which rubble masonry work is to be carried out shall be cleared of all loose materials, cleaned properly and wetted. Every stones shall be carefully fitted to the adjacent stones so as to form neat and close joints. Stones shall be laid in such a manner that all joints are full of mortar. Joints shall not be more than 25 mm thick. Face stone shall tail back and bond well into the backing. As far as possible, stones shall be arranged so as to break joints. Long vertical lines of the joints shall be avoided. Their height shall not be greater than the breadth of the face or the length of tail, into the wall, as directed by Engineer.

The masonry work shall be carried out uniformly, when one part of the work is required to be delayed, the work shall be racked back at an angle not exceeding 40°. Tothing in masonry shall not be allowed. Bond or through stones running right through shall be provided in the walls. For other works exceeding 600 mm in thickness, a line of these which overlaps each other at least 150 mm shall be laid from face to back. At least one bond or through stone shall be inserted for every square meter of the surface. The rubble masonry work shall be carried out in such a manner that not more than 1 mtr. height masonry work is constructed in a day.

**2.4** For all work below ground level, the masonry shall be random rubble uncoursed and with simultaneous flush pointing wherever plaster is not specified with ordinary quarry dressed stones for hearting and faced with selected quarry dressed stones.

**2.5** For all work above ground level and in superstructure, the masonry shall be random rubble, well bonded, faced with hammer dressed stones with squared quoins at joints and corners. The stone used for the masonry in superstructure above ground level shall be out of best quality stone. The contractor shall produce samples of such stones well in advance for the approval of Engineer and all the stones used in structure shall conform to the approved samples.

**2.6** No stones shall tail in the wall, either with a point or to length less than 1-1/2 times its height. The thickness of the joints shall not exceed 12 mm.

**2.7** Splays and pinning shall not be allowed to show on the face of the wall. Two bond stones each of minimum area of 500 cm<sup>2</sup> for every 1.0 sq. m. of each wall face shall be provided. There shall be through stones in walls 600 mm thick and under. In walls thicker than 600 mm, the minimum length of bond stones shall be 2 1/3 times the thickness of walls. The stones for hearting of the wall shall not be less than 150 mm in any direction. Chips and splays shall be wedged in to avoid thick mortar beds and joints. The quoins shall be of selected stones neatly dressed with chisel to form the required angle and laid header and stretcher alternately. The wall faces, comers and joints of opening shall be truly vertical. The joints of exposed, face of the work shall be carefully and neatly raked.

## **2.8 MORTAR**

The mortar for the work shall be as specified in respective items of work and shall be prepared as stated under brick work.

Masonry shall be kept constantly moist on all the faces for a minimum period often days or more.

**2.9** Miscellaneous inserts in masonry e.g. sleeves, wall ties, anchors, conduits, structural steel, steel lintels etc, shall be installed by the contractor. Openings etc. shall be provided as shown on the drawing to receive windows, louvers, door frames, circular openings for exhaust fans etc. In case conduits/junction boxes for electrical works are installed by the other agency prior to construction of masonry, maintaining the alignment of these during masonry and plastering shall-be responsibility of the main civil contractors. Wall ties and flashings shall be built into the brick work in accordance with the rates quoted by the contractor include leaving openings in masonry work for various treads etc.

## **2.10 MEASUREMENT**

The unit of measurement shall be cum. or part thereof. Actual quantity of masonry shall be calculated from dimensions shown on the drawings, less openings and shall be paid for providing openings and chases wherever necessary shall be covered in the quoted rate. No deduction shall be made for opening up to 0.1 m<sup>2</sup> in area.

## **3. RUBBLE SOLING**

**3.1** Rubble used for soling under floors, foundations etc. shall be sound, hard, angular, durable rock and free from defects like veins, flaws, cavities, weathered portion and other defects. The quality and size of the rubble shall be subjected to the approval of the Engineer. It shall be large, flat bedded and regular in shape as possible.

**3.2** Rubble shall be hand packed in one layer only or as directed by Engineer. This shall be laid closely in position on the well prepared sub-grade. The rubble shall be set vertically with the largest face as the horizontal base and packed close to each other. All interstices between the stones shall be wedged-in with smaller stones of suitable size well driven to ensure tight packing and complete filling

of interstice. Such filling shall be carried out simultaneously with the placing in position of rubble stones and shall not lag behind. Projections, if any, shall be knocked off with hammer.

**3.3** Small interstices shall be filled with murrum and well watered and rammed with mechanical (heavy) rammer or hand rammer as approved by the Engineer. Care shall be exercised to avoid damage to the grade beams and columns and trench wall edges while ramming. The surface shall be finished to levels and grades, after watering and thoroughly ramming. Rubble packing in plinth shall be started after the masonry plinth walls are fully cured.

#### **3.4 MEASUREMENT**

The unit of measurement shall be sq.m. for the specified thickness of rubble soling.

### **4. CEMENT POINTING**

#### **4.1 PREPARATION OF SURFACE :**

The joints shall be raked out properly and projection of stones chiselled if necessary. Dust and loose mortar shall be brushed out. Efflorescence, if any, shall also be removed by brushing and scraping. The surface shall be thoroughly washed with water cleaned and kept wet before pointing is commenced. The entire area shall be protected by a removable/non-staining coating of suitable approved material.

#### **4.2 MORTAR**

Mortar mix for pointing shall be as described in the schedule of quantities specifications for cement sand and water shall be described herein before for "concrete works". Sand used for mortar shall be fine and washed if directed.

##### **4.2.1 Application of mortar finishing**

The mortar shall be pressed into the raked out joints, with a pointing trowel, either flush, sunk, ruled or raised according to type of pointing specified in the schedule of quantities. The mortar shall not spread over the face of masonry corners, edges of the masonry but restricted to the width of joints only.

The superfluous mortar shall then be struck off and the surface of the masonry shall be cleaned off completely, including removing the protected coating mentioned above.

#### **4.3 CURING:**

The pointing shall be kept wet for at least seven days. During this period it shall be suitably protected from all damages.

#### **4.4 MODE OF MEASUREMENT**

The area of masonry surface actually pointed will be measured net and shall be paid for. The measurement of length and height of walls pointed shall be taken correct to centimeter. All the openings of doors, windows, ventilators etc. shall be deducted and all jambs, soffits, sills etc. if pointed will be measured to arrive at the net area for the payment. The rate shall include cost of all materials, labour, transport, scaffolding, curing etc. In general the rules of deductions shall be same as indicated ahead under clause 5.7.

### **5. PLASTERING WORK**

#### **5.1 MATERIALS**

##### **5.1.1 Sand, cement and water**



The specifications of cement, sand and water as stated in specifications for R.C. Concrete will also hold good for this work. Only one brand of cement shall be used as far as possible.

### **5.1.2 Neeru**

Neeru shall be prepared from best available hydraulic lime slaked with fresh water and shifted. The lime shall be ground fine in a mortar mill and kept moist until used. A sample of lime used for neeru shall be produced by the contractor for the approval of Engineer-in-charge. Sample of lime may be subjected to tests as per relevant IS before final approval. All lime/neeru used on the work shall conform to the approved sample.

### **5.1.3 General**

Double scaffolding shall be adopted for all plaster work unless permitted otherwise by the Engineer. No holes shall be made in the masonry for supporting the scaffolding. The scaffolding members shall not be tied to windows or door frames and other members provided in the walls. The rate for all plaster work shall also include for making good and completing the plaster after the flooring, skirting or dado tiles are laid either by the same or any other agency. No extra will be paid for making grooves in the internal plaster work, as the rate of internal plaster is deemed to include providing grooves.

## **5.2 CEMENT PLASTER WITH SMOOTH CEMENT FINISH**

**5.2.1 General:** Cement and fine screened sand shall be thoroughly mixed dry in the proportion specified. Only minimum water shall than be added and the mortar mixed thoroughly until homogeneous and required consistency is obtained. NO more mortar shall be mixed than can be used up in half an hour.

**5.2.2 Preparatory work :** The surface to be plastered shall first be thoroughly cleaned and all joints raked out at least 12 mm deep to serve as keys. The raking shall be done carefully and no chipping of the masonry shall be allowed. All concrete surfaces shall be hacked to provide necessary bonding for the plaster. The rate for plaster should include the hacking of surfaces also. All dirt, soot, oil paint or any other material that might interfere with satisfactory bond shall be removed. Soft and crumbling brick and stone work, oil soaked material and timber are not suitable for receiving plaster directly and therefore, the surface shall be brushed and washed with fresh water and maintained in a thoroughly wet condition for 24 hours before commencing plastering. The plastering shall not commence until the preparatory work is approved by the Engineer.

**5.2.3 Scratch or first coat:** The cement mortar for the plaster work shall be (1:4) for all coats. The plaster shall be applied with somewhat more than the required thickness and levelled with a wooden trowel so that the final plaster after trowelling is measured about 15 mm thick in the case of RCC walls, columns and brick walls and 10 mm thick for ceiling, soffits of beams from the face of the backing to the plastered surface. It shall be carried to the full length of the wall or to natural breaking points like doors or windows. Before the scratch coat hardens, the surface shall be cross scratched to provide mechanical key for the final coat. The cross-scratching shall be horizontal as far as possible to aid curing. The surface shall be kept continuously damp for at least two days immediately following its applications. It shall be allowed to dry. If the thickness of plaster is less as specified in the item then thickness of first coat if required shall be as directed by Engineer.

**5.2.4 Finish coat:** Fine sand of approved quality shall be used for finish coat. The finish coat shall be about 5 mm thick. There shall be at least 3 days interval between application of the first coat and finish coat. Before applying the finishing coat, dampen the first coat evenly by frog spray wherever possible and the coat shall be applied from top to bottom in one operation eliminating joining marks. The plaster shall be well pressed into the joints and the surface rubbed smooth after floating it with a coat of pure Portland Cement. The use of dry cement shall not be permitted.

**5.2.5 Watering and curing :** All plaster work shall be kept damp continuously for a minimum period of 10 days after the application of finishing coat. To prevent excessive evaporation of the sunny or windward sides of building in hot dry weather, matting or gunny bags should be hung over the outside of the plaster kept moist. Should the plaster crack through neglect of watering or for any other fault of the contractor, the work shall be removed and redone at the contractor's expense, or should the contractor fail to water the work to the satisfaction of the Engineer, the latter may engage requisite men to water the work properly at cost of the contractor.

**5.2.6 Cement plaster on concrete surface :** The first coat shall not be dashed unless the surface is considered by the Engineer to be sufficiently rough to ensure adequate bond for the rendering coat when applied with trowel. The dashing coat shall be applied by using a strong whipping motion at right angles to the face of the wall. When plastering the concrete surfaces they shall be sufficiently roughened to ensure proper bond. Cost of hacking or roughening of such surfaces or of any other operation to ensure bond, shall be deemed to be included in the rate for the item of plaster.

Where a plaster in single coat is specified the same shall be carried out as described above for item of cement plaster in one coat.

### **5.3 CEMENT PLASTER WITH NEERU FINISH :**

The same specification is applicable for this type of plaster except that the plaster is applied in single coat to specified thickness and instead of cement slurry neeru shall be applied as thin as possible to avoid surface cracking and rubbed over to an even smooth finish. Thickness of plaster shall be as specified in relevant item. Plaster shall be kept wet for about 10 days and shall receive one coat of white wash finally. The contractor shall take every precaution right from the commencement of plaster work to prevent any crazing or cracking that may appear on the plaster surface. He shall be responsible for making good any portion of the plastered surface which in the opinion of the Engineer removal and redoing.

The rate shall also include for making good on completing the plaster after the flooring, skirting or dado tiles are laid either by him or by any other contractor and no extra will be paid on this account.

#### **5.3.1. Whitewashing**

White wash shall be prepared from fresh burnt lime stone or shale lime. The lime shall be of 'c' type as mentioned in I.S. : 712-1956. The lime shall be dissolved in a tub with sufficient quantity of water (about 4.5 litres/kg, of lime) and thoroughly mixed and stirred until it attains the consistency of thin cream. The wash shall be taken out in small quantities and strained through a clean coarse cloth. Alternatively ready made whiting complying with I.S. : 63-1960 may also be used. Clean gum dissolved in hot water shall then be added in suitable proportion of 2 gm. of gum arabic to a litre of lime or whiting. (2 oz of gum arabic to 1 cft. of lime) to prevent the white wash coming off easily when rubbed. Rice size may be used instead of gum.

The surface shall be prepared by removing all mortar dropping and foreign matter and thoroughly cleaned with wire or fine brush or other means as may be ordered by the Engineer to produce an approved clean and even surface. All loose pieces and scales shall be scraped off and holes filled with mortar, which shall be cured afterwards.

On the surface so prepared, the white wash shall be laid. Each coat shall be laid on with a brush. The first stroke of the brush shall be from the top downward, another from bottom upwards over the first stroke and similarly, one stroke from the right and other from the left over the first brush before it dries. This will form one coat. In all, three such coats of white wash or as specified in the schedule shall be applied and should be approved by the Engineer. Each coat must be allowed to dry and shall be subject to present a smooth and uniform finish free from the brush marks and it should not come off easily when rubbed with fingers. Doors, floors, windows, etc. shall be protected from being splashed

upon. Splashing and droppings, if any shall be removed and the surface cleaned. The white wash shall be applied to surfaces of neeru plaster immediately after the neeru plaster is completed and cured.

#### **5.4 WATERPROOF CEMENT PLASTER**

The same specification as detailed for cement plaster with neeru finish shall apply to this plaster also. However, plaster shall be finished smooth with neat cement instead of neeru finish. The approved water proofing compound shall be arranged by the contractor. No extra shall be paid for providing and mixing this in the mortar as directed.

#### **5.5 ROUGH CAST CEMENT PLASTER**

**5.5.1** General procedure for surface preparation for plaster viz. hacking the concrete surface, raking the joints of masonry to a depth of at least 15 mm and cleaning and wetting of brick masonry for this type of plaster shall be similar to the cement plaster. Rough cast plaster shall be done in two operations, backing coat, and finished coat after a short interval. The proportions of cement and sand shall be 1:4 in backing coat and in the finishing coat 1:3. The gravel shall be of a size passing through 15 mm mesh of uniform size but retained completely on 10 mm mesh. The sand gravel shall be washed to remove all dust and silt. The constituents shall be thoroughly mixed dry until the mix is homogeneous. Water shall then be added gradually to the required extent and the material turned over sufficiently to a homogeneous mass of uniform colour.

**5.5.2** Backing of 12 mm thick shall be applied first, in cement mortar 1:4, finished with wooden floats and left rough. Waterproofing compound "Accorproof/Impermo" 2% by weight of cement shall be added in the backing coat. No extra shall be paid to the contractor for providing and mixing this into the work as directed. As soon as the backing coat is slightly set, after a lapse of small interval, the finishing coat (13 mm thick) of rough cast plaster should be started. The mixture of cement, gravel in the proportion as specified above shall be added and the mixture shall be dashed by means of trowels against the backing coat. The gravel should be seen prominently on the surface. The dispersion of gravels shall be uniform all over the surface. The plastered surface should be kept constantly wet for at least 10 days.

#### **5.6 SANDFACED CEMENT PLASTER**

**5.6.1** Surface preparation shall be done in the same manner as for rough cast plaster. Sand faced plaster shall be done in two coats. Backing coat shall be in C.M. 1:4 and finishing coat shall be in C.M. 1:3. The sand to be used for the finishing coat shall be screened to pass through 3 mm mesh sieve and all material passing through 1.5 mm mesh sieve shall be eliminated. The sand shall be thoroughly washed to remove all dust and silt. The cement and sand shall be mixed dry until the mixture is homogeneous and water shall then be added gradually to the required extent, the mixture being turned over as often as required to produce a homogeneous mass of uniform colour.

**5.6.2** Backing coat of 12 mm thick shall be applied first, in cement mortar 1:4. Waterproofing compound "Accorproof/Impermo" or any other approved compound @ 2% by weight of cement shall be added in the backing coat. No extra shall be paid for providing and mixing this in the mortar as directed. The surface shall be made even and uniform by means of wooden floats and roughened with wire brushes, to give a good bond to the finishing coat. The backing coat should then be thoroughly cured for at least 7 days before the finishing coat is taken in hand. The final coat of 8 mm thick in C.M. 1:3 should then be applied uniformly with wooden float. The entire surface should then be rubbed with approved sponges to expose the sand grains uniformly and predominantly. The surface shall be cured again for at least 10 days. The use of mechanical means shall be permitted if demonstrated job is approved by the Engineer.

#### **5.7 MEASUREMENTS**

**5.7.1** The unit of measurement for all the plaster items shall be sq.m. The measurements shall be taken on unplastered surfaces. The rate of internal plaster shall include the cost of providing grooves. Openings up to 0.50 m<sup>2</sup> each in area or for ends of joists, beams, posts, girders, steps, etc. not exceeding 0.50 m<sup>2</sup> each in area, and for openings exceeding 0.50 m<sup>2</sup> not exceeding 3 m<sup>2</sup> in each area, deductions and additions shall be made in the following manner:

a) No deduction shall be made for ends of joists, beams, posts, etc. and openings not exceeding 0.50 m<sup>2</sup> each and no addition shall be made for reveals, jambs, soffits etc. of these openings not for finish to plaster around ends of joists, beams posts, etc.

b) Deduction for openings exceeding 0.50 m<sup>2</sup> but not exceeding 3.0 m<sup>2</sup> each shall be made as follows and no addition shall be made for reveals, jambs, soffits sills etc. of these openings :

(i) When both surfaces of wall are plastered with same plaster, deduction shall be made for one surface only.

(ii) When two surfaces of wall are plastered with different type of plaster or if one surface is plastered and the other pointed, deduction shall be made from the plaster or pointing on the side on which width of reveals is less than that on the other side but no deduction shall be made on the other side. Where widths of reveals on both surfaces of wall are equal, deduction of 50 percent of area of opening on each surface shall be made from areas of plaster and/or pointing as the case may be.

(iii) When only one surface is plastered and the other surface is not, full deduction shall be made from plaster if width of reveal on plastered side is less than that on unplastered side but if widths of reveal on both sides are equal or width of reveal on plastered side is more, no deduction shall be made.

(iv) When width of door frame is equal to thickness of wall or is projecting beyond thickness of wall, full deduction for openings shall be made from each plastered surface of wall.

**5.7.1** In case of openings of area above 3.0 m each, deduction shall be made for opening on each surface but jambs, soffits and sills shall be measured, and paid for.

## **5.8 GROOVES IN THE EXTERNAL PLASTER**

The horizontal and vertical grooves shall be exactly to the required depth and width as shown in the drawings. The grooves shall be neatly finished with extreme care. All horizontal and vertical grooves shall be in perfect straight lines without any break in the continuity. Actual length of grooves shall be measured for payment. Only such grooves as specified in the drawing shall be paid for.

## **6. FLOORING, SKIRTING AND DADO**

### **6.1 CONCRETE (IPS) FLOORING WITH 'IRONITE' / 'HARDONATE' TOPPING AND WITH -OUT 'IRONITE' TOPPING**

**6.1.1** The specifications for cement, sand and aggregates etc. shall be same as stated for reinforced concrete work. The concrete flooring shall be 50 mm thick with plain concrete mix of proportion as specified. The sand shall be screened and thoroughly washed to remove all dust and silt. The coarse aggregate shall be of approved quality well graded and shall not exceed 10 mm size. The coarse aggregate shall also be washed thoroughly to remove all dust and dirt. The cement to be used shall be of one brand only. The surface to be paved shall be thoroughly hacked, cleaned of all mortar, loose materials etc. and washed to remove the mud and dirt from the surface. Unless and until the surface is approved by Engineer, the paving should not be started. The surface to be paved shall then be wetted for at least 24 hours, before the paving is taken in hand. Before placing the concrete for flooring, neat cement slurry shall be thoroughly brushed into the prepared surface of the base concrete just ahead of the finish. Only minimum quantity of water required for mixing and making concrete workable, shall be used and the paving consolidated thoroughly by compacting with heavy wooden battens. The surface shall be trowelled smooth without using any extra cement, either dry or in the form of slurry. The

trowelling shall be continued until moisture ceases to exude from the mass. The paving shall be cured for at least 15 days and it shall be protected during this period with Hessian or other suitable material which will not stain the surface. The laying and finishing shall conform to I.S.: 2571.

The paving shall be laid in alternative bays of size 1.5m x 1.5 m with glass/aluminium dividing strips of size 25 mm x 3 mm thick wherever specified. The formwork required for setting the bays shall not be paid extra.

#### **6.1.2 Ironite topping:**

If 'IRONITE' or equivalent is specified as a floor hardener, the cement concrete flooring shall be laid in as described above and the top finished with "IRONITE". The ironite shall be first mixed dry with cement in a - proportion 1:4 by weight (one ironite to 4 part of cement) and this mixer shall be sprinkled uniformly on the top of green cement concrete flooring after the concrete is consolidated with wooden battens and before trowelling commences. The ironite to be used shall be such that 1.5 kg. of ironite is utilised for 1 sq.m. of area of cement concrete flooring. The total thickness of flooring including the ironite topping shall be as specified in the item.

Measurements for flooring shall be for the actual area covered between the faces of skirting, deductions will be made for columns, projections, equipment foundation, trenches, openings etc. Unit of measurement will be sq. m.

#### **6.2. MONOLITHIC REINFORCED CEMENT CONCRETE FLOORS**

The same specifications for reinforced concrete described hereinbefore shall apply for this type of flooring also. Before the top surface of the base concrete has set, the ironite topping shall be laid monolithically with the base concrete as described above. The size of panels for this type of flooring shall be described in the item. It is to be noted that the reinforcements for the floor are in two layers and continuous at the panel joints and the shuttering shall be properly formed to pass the reinforcements and preclude cement slurry from oozing out. Wherever no ironite is specified total thickness shall be exclusive of ironite topping. When ironite topping is specified it shall be as described in para 6.1.2. and thickness of RCC floor shall be as specified.

#### **6.3 CEMENT PLASTER SKIRTING :**

Preparation of surface and application shall be similar to the plaster with neeru except that it will be finished smooth with neat cement.

Unit of measurement shall be sq. m.

#### **6.4. PLAIN CEMENT TILE FLOORING AND SKIRTING :**

**6.4.1** Cement tiles shall be of size 250 mm x 250 mm x 20 mm thick hydraulically pressed and shall be of best quality obtained from approved manufactures. The tile shall be uniform in size, true and square, free from twist, cracks, depressions or any other defects. The tiles shall be perfectly smooth finished and machine polished on the wearing surface and roughened or keyed on the bedding face. The tiles shall be tested for wearing strength, transverse strength, absorption test as per respective I.S. code. Contractor shall bear all charges for test.

The shade of tile shall be as approved by the Engineer-in-charge. Samples of different varieties of tiles shall be first submitted to the Engineer and got approved by him prior to placing the order for bulk supply. All tiles which go into the work shall strictly conform to the samples approved by the Engineer, failing which the entire materials are likely to be rejected. The sample of lime mortar shall be got approved by the Engineer and the material shall conform to the approved sample. Engineer may ask for testing of a sample from bulk supply. If failed, contractor shall remove bulk from the site.

Before laying the lime mortar bedding, the concrete floor surface shall be thoroughly hacked, cleaned of all mortar scales and concrete lumps etc. and washed to remove mud, dirt etc. from the surface and shall be thoroughly wetted. Unless and until the surface is approved by the Engineer, the flooring shall not be started. A bedding of lime mortar 1:2, 20 mm thick shall then be laid evenly and to the required slope as directed. The cement tiles shall then be laid on the bedding with cement floating. All tiles shall be truly and evenly set in a thick slurry of neat cement applied to the sides and bottom and over the prepared base. The tiles shall then be tamped down with a wooden mallet until they are exactly in true place and line with the adjacent tiles. All tiles shall be extended upto the masonry wall and underside of plaster. The tiles shall be close jointed and the cement slurry coming out through the thin joints shall be immediately wiped clean.

The joints shall then be pointed with matching cement and finished neatly. The flooring shall be kept wet and protected for at least 7 days before starting of polishing. When the flooring is ready for polishing the joints shall be first rubbed with carborandum stones, so that slight projections or edges rising above the surfaces are levelled properly. The entire flooring shall be machine polished in 3 stages with different grades of polishing stones in the machine. The finished flooring shall be perfectly smooth, uniform and with lustre on the surface.

Measurements for flooring shall be clear between the finished (skirting) surfaces. Deductions shall be made for columns, projections, equipment foundations, trenches, openings etc. Unit of measurement shall be sq. m.

**6.4.2** Plain cement tiles in skirting shall be of size 250mm x 100 mm x 20 mm thick hydraulically pressed and shall be obtained from the same source. The shade of the skirting tiles shall be exactly similar to that of flooring tiles. The specifications for materials and workmanship shall be same as for flooring except that the skirting tiles shall be laid against a 20 mm thick bedding of cement mortar 1:4 to the full height of skirting. The skirting tiles shall be in true plane level and plumb. The skirting shall be laid projected beyond the finished plastered surfaces. The skirting shall be polished with hand to attain the same finishing as for the flooring. The skirting shall be cured for 7 days.

Measurements shall be for the actual area of skirting and deductions shall be made for the areas not covered by skirting. Unit of measurement shall be sq. m.

## **6.5 TERRAZZO TILE FLOORING AND SKIRTING :**

**6.5.1** Terrazzo tiles shall be of size specified in the item, hydraulically pressed and shall be best quality obtained from approved manufacturers. The tiles shall be uniform in size, true and square, free from twist, cracks, depressions or any other defects. The tiles shall be tested for wearing strength, transverse strength, absorption test as per respective I.S. code. Contractor shall bear all charges for test. The wearing surface of the coloured terrazzo tiles shall consist of coloured terrazzo finish of not less than 7 mm thickness using marble chip of best available variety. The tiles shall perfectly smooth finished and machine polished on the wearing surface and roughened or keyed on the bedding face.

The design and shade of the tile shall be as approved by the Engineer, samples of different varieties of tiles shall be first submitted to the Engineer and got approved by him prior to placing the order for bulk supply. All tiles which go into the work shall strictly conform to the sample approved by the Engineer, failing which the entire materials are likely to be rejected. Engineer may ask for testing of a sample from bulk supply. If failed, contractor shall remove bulk from the site.

Before laying the lime mortar bedding, the concrete floor surface shall be thoroughly hacked, cleaned of all mortar scales and concrete lumps etc. and washed to remove mud, dirt etc. from the surface and shall be thoroughly wetted. Unless and until the surface is approved by the Engineer, the flooring shall not be started. A bedding of lime mortar 1:2 and of specified thickness shall then be laid evenly and to the required slope as directed. The sample of lime mortar shall be provided by the contractor for the approval of Engineer and the material used shall conform to the approved sample. The terrazzo tiles shall then be laid on the bedding with

cement floating. All tiles shall be truly and evenly set in a thick slurry to neat cement applied to the sides and bottom and over the prepared base. The tiles shall then be tamped down with a wooden mallet until they are exactly in true plane and line with a adjacent tiles. All tiles shall be extended upto the masonry wall and underside of plaster. The tiles shall be close jointed and the cement slurry oozing out through the thin joints shall be immediately wiped clean. The joints shall then be pointed with matching cement and finished neatly. The flooring shall be kept wet and protected for at least 15 days before starting of polishing. When the flooring is ready for polishing, the joints shall be rubbed with carborandum stones so that slight projections or edges rising above the surfaces are levelled properly. The finished flooring shall be machine polished in 3 stages with different grades of polishing stones in the machine. The finished flooring shall be perfectly smooth, uniform and with lustre on the surface the polishing treatment shall also include a coat of grouting of tiles with matching cement after the first stage of polish. After the final polish oxalic acid crystals ground into powder shall be dusted over the surface at the rate of 32.5 gm/m<sup>2</sup> sprinkled with water and rubbed hard with a pad of woollen rages by means of polishing machine. The finished floor shall give a nifrom shade of tiles and any defective tiles of scratched in tiles etc. are observed, the same shall be made good at contractor's own cost.

Mode of measurements shall be similar to cement tile flooring,

**6.5.2** Terrazzo tiles in skirting shall be of specified sizes in the item, hydraulically pressed and shall be obtained from the same source as for the terrazzo tiles for flooring. The design and shade of the skirting tiles shall be exactly similar to that of the flooring tiles. The specifications for materials and workmanship shall be same as for flooring except that the skirting tiles shall be laid against a 20 mm thick bedding of cement mortar 1:3 to the full height of skirting.

The skirting tiles shall be in true plane level and plumb the skirting shall be laid projected beyond the finished plastered surfaces. The continuous horizontal grooves at the top of the skirting shall be provided if required as per drawing or as directed by the Engineer. No extra will be paid for such grooves. The skirting shall be polished with hand to attain the same finish as for the flooring. The skirting shall be cured for 7 days. The specifications for dados will be the same as for skirting. The size of tiles for dado however will be 250 mm x 250 mm x 20 mm thick.

The measurements shall be the actual area of skirting, dado etc. and deduction shall be made for the areas not covered by these. Unit of measurement shall be Sq. m.

## **6.6. TERRAZZO IN - SITU :**

**6.6.1** Surfaces of the wall, concrete etc. shall be thoroughly cleaned of dirt, dust and water. Free water shall be removed, and mortar bedding consisting of cement mortar 1:4 of thickness as specified in the schedule, shall be laid to proper level or slopes, curved profiles etc. as directed by the Engineer. Aluminium dividing strips of size 25 mm x 3 mm thick shall be provided as indicated in the drawing and these shall be fixed in mortar to proper line and level and as shown in the drawing. After the mortar base has sufficiently hardened, the terrazzo mixture consisting of 1 part of cement of approved colour and shape with 2 parts of approved marble chips with same binding materials shall be placed to proper level and slope over the bedding of mortar. Just before the initial set takes place, the top surface shall be rammed and trowelled to bring the maximum number of marble chips on the surface. No part of the surface shall be left without marble chips. The surface shall then be cured for at least 14 days. After the work is set and hardened the surface shall be polished smooth and even. Cast-in-situ terrazzo skirting shall match with the design and shall be similar and give the same effect of distribution of marble chips and colour as for treads and risers. The mode of measurement shall be same as for dados.

## **6.6.2 PRECAST TERRAZZO TREADS AND RISERS**

All precast terrazzo treads and risers shall be of approved manufacture and uniform in thickness, size true and square, free from cracks or any other defects. The shade and design of treads and risers shall be as directed and approved by the Engineer. The specification for surface preparation and

workmanship shall be similar to terrazzo tile flooring and skirting. The precast terrazzo treads shall have grooves at the nosing for non-slipping as shown in the detailed drawings.

The treads shall be laid on 1:3 cement mortar bedding and risers on 1:4 cement mortar bedding and hand polished to the complete satisfaction of the Engineer.

**6.6.3** Cast-in-situ terrazzo for skirting cast-in-situ terrazzo finish shall match the precast terrazzo treads and risers. The shade and design shall be similar and shall give the same effect of distribution of marble chips as for treads and risers.

The specification for surface preparation shall be similar to terrazzo tile flooring and skirting. The thickness of the terrazzo shall be as specified in the items and shall be laid over cement mortar 1:3 bedding. The situ work shall be done in best workman like manner with skilled and experienced masons. The terrazzo cast-in-situ for skirting shall be flush and in line with plastered surface above and with a groove formed on top of skirting as shown in the detailed drawing. The terrazzo cast-in-situ work shall be cured for at least 10 days and hand polished to the complete satisfaction of the Engineer-in-charge.

## **6.7 KOTAH STONE FLOORING, SKIRTING AND DADO, TREADS AND RISERS ETC.**

Kotah stone shall be of best quality and of thickness specified and obtained from approved sources. Kotah stones shall be of sizes stipulated in the items of schedule of quantities. The stone shall have to be machine cut/hand cut as specified and double machine polished wherever required as per item. The edges to be pointed shall be true to line and dressed to the depth all around. The stones shall be hard, sound, free from cracks, veins and other defects and of uniform colour. The samples of stone shall be submitted for approval of the Engineer and all the stones incorporated in the work shall conform to the approved samples. Before laying the flooring surface to be paved shall be thoroughly hacked, cleaned of all mortar scales, concrete lumps, loose materials etc. Unless and until the surface is approved by the Engineer, the paving shall not be taken in hand.

### **6.7.1 KOTAH STONE FLOORING**

If found necessary the permission shall be given by the Engineer to dress the stones at site. A bedding of lime mortar 1:2 and 20 mm thick shall be laid evenly and to the required slope as directed. The stones shall then be truly and evenly set in a thin paste of neat cement applied to sides, bottom and to the prepared base. The stones then be tamped down with wooden mallet until they are exactly in true plane and with the adjacent stones. All stones shall be extended upto the masonry wall and underside of the plaster. The stone shall be close jointed and shall be as thin as possible. The cement that oozes out through the joints to the surface shall be immediately wiped clean. The joints shall then be filled with matching cement and finished neatly. The entire surface of flooring shall be repolished with machine to satisfaction of the Engineer. The edges of stones wherever exposed shall be machine cut. The flooring shall be cured for 7 days.

Measurements for flooring shall be for the actual area covered from face of skirting. Deduction will be made for columns, projections, equipment foundations, trenches, openings etc. Unit of measurement shall be sq. m.

### **6.7.2 KOTAH STONE SKIRTING, DADO, TREADS AND RISERS**

They shall be laid, against a bedding of cement mortar 1:3 to the full height to a true plane, level and plumb. The workmanship shall be similar to flooring. Treads and risers for circular as well as for other staircases shall be in one piece dressed to the shape as shown in drawing and all exposed edges polished to give neat appearance. The skirting shall be laid projected beyond the finished plastered surfaces as directed. The continuous horizontal grooves at the top of skirting shall be provided if specified in the drawing or as directed by the Engineer. No extra will be paid for grooves. The skirting surfaces shall be repolished with hand to satisfaction of the Engineer. The skirting shall be cured for 7



days. Measurement shall be for the actual area of skirting/dado etc. and deduction shall be made for the areas not covered by these.

Unit of measurement shall be sq.m.

### **6.7.3 KOTAH STONE SILLS, COPINGS AND COUNTER TOPS**

The stones shall be cut to the required sizes as approved by the Engineer. The stones shall have to be machine cut and double machine polished wherever specified. The edges to be pointed shall be true to line and dressed to the required depth all round. All the exposed edges shall be neatly polished to give a neat appearance.

These items shall be laid, on a bedding of cement mortar 1:4, 20 mm thick to a true plane, level or slopes all as per prevalent drawings. The workmanship shall be similar to kotah stone flooring described above the sills and copings should project beyond finished plastered surface as shown in drawings. Continuous horizontal grooves wherever specified shall be provided as per drawings and quoted rate is deemed to include for the same. The surface shall be repolished with hand to entire satisfaction of the Engineer. The entire work shall be cured for 7 days. Measurements shall for the net actual exposed area covered.

### **6.8 WHITE GLAZED TILE FLOORING AND DADO**

White glazed tiles shall be 150 mm x 150 mm x 6 mm thick in size and of best quality. Indian make obtained from approved sources as stated in the item of work. But the items shall be from one source only. White glazed tiles shall be pure white in colour. The tiles shall be sound, hard well and evenly glazed, free from cracks, twist with fine and sharp edges. Different makes of tiles shall be brought for the approval and samples of tiles shall be first got approved by the Engineer and all the tiles which shall be used in the work shall strictly conform to the approved sample otherwise all the tiles will be rejected. The contractor has to arrange testing of tiles as per I.S. for craziness, absorption, strength etc. at his own cost. Engineer may ask for testing of a sample from bulk supply. If failed, contractor shall remove bulk from the site. The surface to be laid with flooring or dado shall be thoroughly hacked. Joints of masonry raked, cleaned of all mortar scales, concrete lumps, loose materials etc. and washed to remove mud, dirt etc. from the surface. Unless and until the surface is approved by Engineer the flooring or dado shall not be started. The prepared surface shall be thoroughly drenched with water. The glazed tiles and all specials shall be soaked in water for a minimum period of 6 hours before use.

#### **6.8.1 FLOORING**

A bedding of cement mortar 1:3 and 20 mm thick shall be laid evenly to levels or slope as directed. The white glazed tiles shall then be laid on the bedding with a backing thin cement paste. All tiles shall be truly and evenly set and pressed in position to obtain uniform plane surface. The tiles shall be close jointed and all joints shall be uniform and as thin as possible and run in perfect straight lines. The joints shall be staggered or continuous as directed. The other specials like corner edges, elephant foots, bull eyes, etc. shall be used at the proper places wherever required and as directed. The entire finished surface shall be thoroughly cleaned to remove all cement stains etc. The joints shall be then pointed with a neat white cement and the flooring shall be kept wet for 7 days or more. The flooring shall be thoroughly cleaned with suitable hydrochloric acid before handing over. If cutting or drilling of tiles is required after the tiles are laid, it shall be done neatly and accurately.

#### **6.8.2 DADO**

The prepared surface shall be plastered with cement mortar 1:3 to get a bedding of 20 mm thick. The plastered surface shall be even, uniform and true to plumb. The white glazed tiles shall be fixed in position with a backing of cement paste. The specifications for workmanship regarding joints, specials, cleaning, pointing, curing etc. shall be exactly similar to white glazed tile flooring.

The mode of measurement for white glazing, flooring and dado shall be same as for terrazzo tile flooring and dado. Deductions shall be made for W.C. pans etc.

## **7. WOOD WORK AND JOINERY ETC.**

### **7.1 WOOD**

Unless otherwise specified all timber shall be of best quality C.P. teak wood well-seasoned and free from cracks, sap wood, knots, sags warps etc. and shall have uniform grains of good pattern. All timber shall be kept dry and well protected from rain and moisture during construction and shall be stored in dry godown approved by the Engineer and protect from fungi, insects and marine borers. The timber shall be wrought and brought to correct dimensions as shown in the drawings. All joints shall be true, of proper fit and of the kind specified by the Engineer. Timber embedded in or in contact with the masonry or concrete shall be painted with 2 coats of approved wood preservative as directed. The rate of wood works shall include the cost of all labour, tools and materials including wood preservative paint, nails, pins, keys, wedges, screws, holdfasts etc. and erecting the same in position and for painting with one coat of approved wood primer, as specified. The rate shall also include for waste if any.

### **7.2 PLASTIC LAMINATE**

This shall be 'Formica' or equivalent approved make and colour. Sample of plastic laminate of different colour shall be submitted by the contractor for approval and all the materials used shall conform to approved samples.

### **7.3 PARTICLE BOARD**

This shall be 'Anchor Board' manufactured by M/s. Indian Plywood Manufacturing Co. or equivalent particle board bonded with Phenol Formaldehyde.

### **7.4 TEAK WOOD FRAMES**

Doors frames shall be of best quality timber of C.P. teak wood as specified and wrought and put up to sections as indicated on the drawings or as directed by the Engineer. They shall be properly framed and mortised and tongued together at right angles and set correctly in the masonry or concrete. The door frame shall rest on structural slab and not on finished floor level M.S. holdfasts 40 mm wide x 3 mm thick x 83 mm long shall be fixed as shown in drawing or as directed by the Engineer to hold the teak wood rough ground frames/door frames firmly in the masonry, where the rough grounds/frames are placed by the side of concrete surfaces. They shall be fixed firmly against the concrete surfaces by means of teak wood gutties and screws. All M.S. holdfasts shall be fastened to the frame using adequate number of M.S. screws and shall be painted with bituminous paint. Surfaces of frames in contact with masonry or concrete shall be painted with 2 coats of bituminous paint.

**7.4.1** The frame shall be as per drawings. All the frames shall be provided with triangular keys for the plaster if indicated in the drawing. All frames shall be protected with one primer coat of approved wood primer as specified. While fixing the frames in position the vertical members shall be held rigid temporarily by means of wooden battens to avoid bending or distortion of members and to keep door frame exactly in plumb. The teak wood beading/cover mould/stopper of the specified sizes shall be fixed on to the frames as shown in the drawing, and shall be free from loose knots and sap wood.

### **7.5 GENERAL FOR WOODWORK AND JOINERY**

**7.5.1** The frame work, styles, rails, mullions, etc. for shutters shall be of first quality of C.P. teak wood as specified and as shown in relevant drawings. The shutter shall be either of single leaf or double leaf having wooden panels or semi glazed panels. Wherever AC sheet panels are mentioned. AC sheet of specified thickness shall be painted with one coat of primer paint as directed by the Engineer.

All necessary rebates, recesses, holds, cutouts etc. for fixing hardware items shall be provided as required and as per drawing.

The rate for the doors shall include the cost of supplying and fixing the frame and shutters, including cost of hardware items including the cost of labour for fixing the same in position as per drawing, all hardware items shall be fixed in the best workman like manner so that the same shall function efficiently. The frames, shutters, mullions, headings, etc. shall be smooth finished withstand papering and shall be painted with one coat of approved wood primer as specified.

**7.5.2** Glazing shall be of Indian make Hindustan Pilkington Sheet Glass, Modiguard or equivalent of special selected quality of thickness as specified. It shall be free from flaws, scratches, cracks, air bubbles, stains, or any other defects and shall be uniform in appearance. Glass shall be cut so as to give a clearance not more than 1.5 mm all round the frames for the opening.

**7.5.3** All the glass panes shall have proper square corners, true and straight edges. The glass panes shall be fixed firmly and truly parallel to the plane of shutters with rubber lining around and wooden beading as per drawing. All damage and breakages during glazing shall be at the contractor's own risk and cost till the work is properly taken over by the Engineer. Wherever if specified all shutters shall be provided with approved type of laminated push plates and kicking plates on both sides of the shutters as per drawing.

**7.5.4** All doors covered under this specification shall be tested for rigid perfect installation, smooth operation of shutters and hardware items. Any damages or rectifications required shall be made good by the contractor without any extra claim.

## **7.6 FLUSH DOOR**

The shutters of the flush door shall be solid core commercial block board of best approved quality. The thickness of shutter shall be as indicated in the relevant items. Teak wood external beading wherever specified, shall be provided to the shutters before fixing in position. The headings shall be of 1st class C.P. teak wood and shall be free from knots, cracks, and other defects. The headings shall be in one length. They shall be fixed to shutters with "Fevicol" or equivalent adhesive and galvanised pins. Shutters may be single leaf or double leaf as per schedule of doors. All necessary rebates, recesses, holes etc. if any for fixtures shall also be provided and visible surfaces finished as specified in the relevant items of schedule of quantities.

**7.6.1.** Necessary openings have to be provided in the shutters as per relevant items and as indicated in the drawings. These openings are intended for glass vision panels or fixed wooden louvers, fire box etc. The contractor shall also provide and fix the vision panel glass with PVC lining all round and teak wood/aluminium headings and the teak wood louvers with necessary frame work as shown in drawings and schedule of quantities.

Chicken wire-mesh of approved make and gauge shall be provided at the junction of the frame and walls/columns as directed by the Engineer. Wherever required chicken mesh shall be paid against the relevant item of schedule of quantities.

## **7.7 TEAK WOOD PANEL DOORS**

The specifications for woodwork and general workmanship shall be the same as for teak wood door above.

## **7.8 FITTINGS AND FIXTURES**

If schedule of fitting & fixtures are not shown in the drawing then the fittings and fixtures for all the doors shall be as given in the following table. All the fittings and fixtures shall be fixed to the door in workmanlike manner as directed by the Engineer.

### **Schedule of Fittings and Fixtures**

**a. Single shutter door**

1.	M.S. Butt hinges 100 mm long (heavy quality)	- 4 Nos.
2.	Godrej or equivalent night latch 7 levers	- 1 No.
3.	Aldrop 250 mm long and 16 mm dia (Alu.)	- 1 No.
4.	Handle D-flat 150 mm long (aluminium)	- 2 Nos.
5.	Tower bolt (Barrel type) 200 mm x 10 mm	- 1 No.
6.	Flat latch 250 mm long (Aluminium)	- 1 No.
7.	Door stopper of approved design fixed to the shutter (Aluminium with rubber buffer)	- 1 No.
8.	Door rubber buffer (50 mm dia)	- 1 No.

**b. Double Shutter door**

1.	Aldrop 250 mm long and 16 mm dia (Aluminium)	- 2 Nos.
2.	Tower bolt (Barrel type) 200 mm x 10 mm (Aluminium)	- 1 No.
3.	Handle D-flat 150 mm long (Aluminium)	- 2 Nos.
4.	Door stopper of approved design fixed to the shutter (Aluminium with rubber buffer)	- 1 No.
5.	Door rubber buffer 50 mm dia	- 1 No.

**7.9** Rate quoted for the items shall cover all the specifications described above and for the complete work as per item of work including all labour, materials such as fittings and fixtures, screws, holdfasts, wood preservative paint, wood primer, glass for vision panels, aluminium beading, PVC lining etc. complete.

**7.10 MODE OF MEASUREMENT**

The door frame shall be measured in cubic metre basis. The mode of measurement for door shutters shall be on square metre and shall be taken on the basis of finished size of the shutter. Double shutter shall be measured in closed position, only.

**8. MILD STEEL DOORS**

**8.1** The hollow mild steel flush doors shall be of size as specified in the drawing and to suit the openings and shall be erected in position as shown in the drawing and as directed by the Engineer all the fittings and fixtures to be provided to doors shall be as follows :

		Single shutter	Double
shutter			
1.	M.S. Butt hinges 100mm long (Heavy Quality)	4 Nos.	6 Nos.
2.	Aluminium aldrop - 250 mm x 16 mm dia.	2 Nos.	2 Nos.
3.	Tower bolt (Barrel type) 200 mm x 10 mm (Aluminium)	1 No.	2 Nos.

4.	Handle D-flat 150 mm long (Alu.)	2 Nos.	2 Nos.
5.	Doorstopper of approved design fixed to the shutter	2 Nos.	2 Nos.
6.	Door rubber buffer (38 mm dia)	1 No.	2 Nos.
7.	Nuts, Bolts, Washers etc. required	As required	As
8.	Vision panel required	As required	As

The doors shall be fabricated from specified gauge of sheets for frames and specified gauge of sheets for shutters, as shown in the drawing or in the item and as directed by the Engineer and the hinges, brackets of aldrops and door stopper shall be welded/screwed to the door as directed by the Engineer.

**8.2** All the doors shall be erected true to plumb and the hold fast shall be grouted in masonry in C.C. 1:2:4 or fixed to RCC members with six numbers of rawl plugs and screws for each member of the door. Mastic shall be filled around the door frame as shown in drawing. Selected quality sheet glass of 5.5 mm thickness of HPG or equivalent make and with PVC liner around shall be provided and fixed by the Contractor to all glazed doors and vision panels wherever indicated. Other specifications for glass shall be as specified for glass for teak wood doors. Hollow frame shall be filled by cement concrete 1:2:4

**8.3** For air tight doors, suitable neoprene linings shall be provided and fixed by the contractor around the frames to make the door perfectly airtight.

**8.4** Contractor's rate is deemed to include all the works as specified above and as shown in relevant drawings, labour, materials such as tools and plants etc. all complete. Unit shall be square meter. Height of the door shall be measured from finished floor level to the top of head member and width from out side to outside of frame. Dimensions shall be measured nearest to 5 mm.

**8.5** Both the leaf of double shutter door may or may not be equal.

## **9 STEEL WINDOWS AND LOUVERS :**

**9.1** Frames for windows, louvers etc. shall be flash butt welded and manufactured from Standard Steel Section conform to I.S. for windows and louvers and shall be free from rust, flakes, cracks, blisters, imperfect edges and all other defects. The windows/louvers shall be of the size as specified in the drawing and to suit the openings and shall be erected in the position as shown in the drawing and as directed by the Engineer. All the windows shall be provided with, following fittings and fixtures of M.S/brass, as per item.

### **I). Top hung**

Peg stay M.S. oxidizes 1 No. for each shutter.

### **II). Side hung**

Peg stay M.S. oxidizes 1 No. for each shutter.

Handle M.S. oxidizes 1 No. for each shutter.

**9.2** Windows shall be erected in position true to line, level and plumb & with best workmanship. The Contractor shall take all precautions to protect the windows from wet cement, lime, dirt, mortar, dust etc. by suitably covering them during plastering etc. The window frames shall be accurately fixed in brick masonry or •RCC work in accordance with IS code of practice. The windows shall have to be

either fixed by means of M.S. cadmium plated screws and rawl plugs in case of concrete surface or by means of hold fasts grouted with cement concrete 1:3:6 blocks of 200 x 100 x 100 mm size into the masonry. All joints between metal and masonry shall be fully caulked with mastic in order to ensure water tight joints. Joints shall be neatly pointed and excess material shall be removed. The window shall be screwed at head, jamb and sills and care shall be taken to ensure that the windows are not distorted when screwing up lugs or fixing screws. The assembled frames shall be fixed in the prepared openings and shall not be fixed in openings which are out of shape or too small. Number of lugs, screws & clips shall be in order of

2 Nos. of each side for frames upto 1.00 M height

3 Nos. of each side for frames upto 1.50 M height

3 Nos. of each side for frames upto 2.00 M height

One additional on each side for every 600 mm or part thereof for height beyond 2 meters. Such lugs, screws or clips shall also be provided at top and bottom at the rate of one each face for every 600 mm length or part thereof (for windows greater than 600 mm width). Concrete sills if specified, shall preferable be laid after windows have been fixed to enable the lugs to be embedded properly. Please see special points under clause 9.7

### **9.3 GLAZING**

The glazing shall be of Indian make Hindustan Pilkington, Modiguard or equivalent sheet glass of best quality & of thickness as specified. It shall be free from flaws, specks, scratches, air bubbles, cracks, stains and other defects etc. and shall be uniform in appearance. All glazing shall be of special selected quality (SSQ) either transparent, ground or figured as specified in drawings. The glass shall be cut so as to give clearance of not more than 1.5 mm around the frames. All the glass panels shall have properly squared comers and straight edges. The glass panels shall be fixed to the frame with rubber lining and aluminium beading around and shall hold the glass to the framework under all weather conditions. The glass panels shall be fixed firmly, truly parallel to the place of shutters. All damages or breakages during glazing shall be at the Contractor's own risk till the work is properly taken over by the Engineer. Best quality putty shall be filled in gap between the beading and glass to hold the glass properly.

All windows shall have glazing fixed on outside and as shown on the drawings with special glazing clips spaced 300 mm apart. All holes in the shutters for such clips shall be provided during fabrication. The putty used shall conform to IS : 420 and shall not be less than 186 gms. per running meter of the glass perimeter. The thickness of the glass shall be as below.

1. 3 mm glazing for glass area not exceeding 0.55 sqm subject to one side not exceeding 1.20 M.
2. 4 mm glazing for glass area between 0.55 sqm to 0.92 sqm where one side does not exceeding 1.20 M.
3. 5 mm glass plate for glass area between 0.55 sqm to 0.92 sqm where one side exceeds 1.20 M.
4. If higher thickness is specified in item, item will govern. If thickness guided above is higher, above will govern. Therefore thickness whichever higher shall govern.

When glass is fixed with putty or wooden beading, it shall be of first class teakwood fixed with putty. Holes for fixing wooden shall not be more than 230 mm apart & machine screws shall be used for fixing. All stains and marks shall be removed from the surface of glazing.

**9.4** All windows shall be tested for water tightness. If any leakages are found during testing, it is the responsibility of the Contractor to rectify the same without any extra claim, the contractor shall also remove all lacquer paint and PVC cover and clean the windows before handing over them to the Engineer. Composite members shall be assembled and joined together with special mastic at the rate of 90 gms. per 0.30 M of the joint. Special mastic shall be used in embedding the frames on brick, concrete or steel surface. All joints between the frames and the plastered surface shall be properly filled with the mastic to make the joints waterproof.

**9.5** Rate for windows shall be for all the work specified as above, as directed by the Engineer and as shown in drawing including all labour material like glass, rubber lining and other incidental charges. Unit of measurement shall be square metre and dimensions shall be outside of completely assembled window out of various units. Measurements shall be taken nearest to 5 mm.

**9.6** Window shall be painted with one coat of approved steel primer before erection.

### **9.7 CONTINUATION OF POINT 8 & 9 - STEEL DOORS & WINDOWS**

While quoting the rates of M.S. doors & windows, in addition to specification, following may please be noted.

1. The welding shall be flash butt, arc welding shall not be permitted.
2. The hinges must be rust free, superior quality and shall have a guaranteed performance while operating window.
3. The fittings as indicated in the specifications and schedule of fixtures must not have weight below IS or equivalent standards.
4. The striking plate shall be of brass or aluminium alloy. The striking plate of M.S. shall not be permitted
5. The hot dipped primer must be applied after removing rust and stains. Application of primer using brush shall not be permitted under this item.
6. Windows must be fixed keeping an around clearance of 12.5 mm to 15 mm.
7. Adequate number of holdfasts spaced not more than 600 mm must be provided and grouted on all four sides of windows.
8. Irrespective of size of holdfast the concrete block shall have dimension equal to width of brick work x 75 mm x 75 mm.
9. Guard bars if specified in the item shall be of 10 mm x 10 mm square. These shall be without cracks, bends & twists. These may have arc welding and primer using brush applications. The spacing of guard bars shall be rounded off keeping in view the max, spacing not to exceed 100 mm.

### **10 STEEL ROLLING SHUTTERS :**

**10.1** The rolling shutters shall of size as specified in the drawing and to suit the openings and shall be erected in position as shown in and to suit the openings and shall be erected in position as shown in the drawings and as directed by the Engineer. The rolling shutters shall be gear operated as specified in the schedule of items.

**10.2** The rolling shutters shall be of best quality from approved manufacturers with 18 G.M.S. sheets and shall have 75 mm machine rolled laths, interlocked with each other and ends locked with clips. The side guides shall be of pressed steel channel 75 mm deep and 25 mm wide fixed with necessary holdfasts etc.

**10.3** All components of the rolling shutter shall receive one coat of red lead paint. The rates shall include for supplying and erection complete with pressed steel channel side guides, brackets, suspension shafts, top rolling springs, locking hapse and staples on both side with the bottom lock plates handles, top hood cover made of 20 G. M.S. sheet with necessary stiffeners and framework to prevent sagging, pulling hooks, gear mechanism, gear handles, etc. complete.

**10.4** All springs, hearings and guides shall be properly greased before the assembly. The rolling shutter should be able to operate smoothly without any jerks etc. The springs shall be tightened enough so that the pull and push type rolling shutter remains steady in any position. The fixing shall be done securely and workman like manner to the satisfaction of the Engineer, so that the shutter is smooth.

**10.5** Measurement shall be for clear structural openings in the walls only and the rates shall be square metre of dear structural opening. Hoods etc. will not be measured separately.

**SCHEDULE OF FITTINGS AND FIXTURES  
SPECIFICATIONS FOR STEEL DOORS**

Thickness of door shutter	:	35 mm
Composition of doors	:	Sand-witch construction, premium CRCA ( galvanized) sheets of desired thickness for frame & shutters insulated with polyurethane foam (P.U.F.) of 40Kg/cum. Frame : H.M.P.S. frame (hollow metal press section) of high quality steel. Atmospheric Protection : All doors are pretreated and coated with two pack epoxy primer and two coats of polyurethane paint for protection against atmospheric moisture.
Installation	:	All components are provided in a semi-knocked down condition for easy installation.

**A. Single shutter Door 35mm thick ( Galvanised M.S. Pressed Steel Frame & Shutter )  
"SEN-HARVIC/ABAQUS"**

1.	Special design hinges having 10 mm SS pin with SS -washers detachable type	:	4 Nos.
2.	Aldrop 300mm long, 16mm dia (CPMS)	:	1 No.
3.	Alu. Tower bolt barrel type 200x10 mm dia	:	1 No.
4.	Double legged Alu. Door stopper of approved design fixed to shutter (Alu. With rubber buffer)	:	1 No.
5.	D- Handle flat 150mm long (Aluminium)	:	2 Nos.
6.	Rubber door buffer 50mm dia	:	1 No.
7.	Hydraulic door closure of Godrej make	:	1 No.
8.	Vision Panel size 200x300mm	:	1 No.

**B. Double shutter Door 35mm thick ( Galvanised M.S. Pressed Steel Frame & Shutter )  
"SEN-HARVIC/ABAQUS"**

1.	Special design hinges having 10 mm SS pin with SS washers detachable type	:	8 Nos.
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- |    |   |   |        |
|----|---|---|--------|
| 2. | Aldrop 300mm long, 16mm dia (CPMS)  | : | 2 No.  |
| 3. | Alu. Tower bolt barrel type 200x10 mm dia   | : | 2 No.  |
| 4. | Double legged Alu. Door stopper of approved design fixed to shutter (Alu. With rubber buffer) | : | 2 No.  |
| 5. | D- Handle flat 150mm long ( Aluminium)  | : | 4 Nos. |
| 6. | Rubber door buffer 50mm dia   | : | 2 No.  |
| 7. | Hydraulic door closure of Godrej make   | : | 1 No.  |
| 8. | Vision Panel size 200x300mm   | : | 1 No.  |

**C. Single PVC TOILET DOOR Shutter**

- |    |   |   |        |
|----|---|---|--------|
| 1. | Aluminium Aldrop 250mm long 16mm dia      | : | 1 No.  |
| 2. | Aluminium handle flat 150mm long          | : | 2 No.  |
| 3. | Alu. Tower bolt ban-el type 200x10 mm dia | : | 1 No.  |
| 4. | S.S. Butt Hinges 125mm long               | : | 3 No.  |
| 5. | D- Handle flat 150mm long (Aluminium)     | : | 2 Nos. |
| 6. | Rubber door buffer 50mm dia               | : | 1 No.  |
| 7. | Flat latch 250mm long (Aluminium)         | : | 1 No.  |
| 8. | Vision Panel size 200x300mm               | : | 1 No.  |

**V-D/20**

**SPECIFICATIONS FOR ALUMINIUM DOOR, WINDOWS AND PARTITIONS**

**SCOPE OF WORK:**

The work in general shall consist of supplying and erecting and installation of all aluminium glazed doors, extruded aluminium louvered/glazed windows and glazed partitions, floor springs, glass and glazing, panelling etc.

**MATERIAL:**

The member shall be fabricated out of aluminium alloy conforming to IS 733 latest addition and of extruded sections as manufactured by Indian Aluminium Company Limited or approved equivalent. Intending tenderers shall clearly state the type of the extruded aluminium sections they propose to use of fabrication with its weight per unit length and the name of the manufacturer's. Frames, mullions, transom etc. and other exposed aluminium sections shall be aluminated anodised 0.0006 inches, matt satin finished in natural aluminium colour. A protective transparent liquor coating based on matchcrylates or cellulose butyrate shall be applied to the sections before shipment from the factory. The aluminium louvers shall be extruded section.

## **FABRICATION:**

1. The type of construction of aluminium doors/windows/partitions shall be as per the overall structural openings shown in the schedule/drawings and the fabricator shall take actual dimensions of openings as constructed for each unit prior to commencing of the fabrication.
2. Before starting the fabrication of the aluminium doors, partitions, windows etc. the contractor shall submit detailed fabrication drawing with complete list of fittings facilities and details of method of fixing at the site to the Engineer for approval. Only after approval of the drawing etc., the fabrication shall be commenced. All fabricated items shall be fitted and shop assembled and made ready for installation. All joints shall be mitred at the corners and shall be made to fit to hair lines and then welded or braced by such method as will produce uniform colour throughout the fabricated items. Work on the above, other than described, shall be carefully fitted and assembled with neat joints and with concealed fasteners. Wherever possible, joints shall be made in concealed locations. Filled connections of all works may be made with concealed screws, self tapping or other approved type of fasteners or may be welded with due precautions taken as not to discolour the desired/ required finish.
3. Holes for fixing and coupling sashes shall be provided in the web of the outside frame sections and of outer ventilator frame sections where these occur at the perimeter of the sash. These holes shall be of 8 mm dia. countersunk and shall be located 1.4 cm from the outside face of the frame sections. Holes for the glazing clips shall also be provided, one hole being located in the web of the section or two on each side of each panels. Required number of spring clips shall be provided and this shall be made of spring steel to the required design (The pins for the hinges shall be of stainless steel or non-magnetic type or of aluminium alloy H.R. 30 and shall be anodised with a minimum thickness of 0.025 mm duly sealed with oil, wax or lenolin).
4. Portions of aluminium frames which come in contact with masonry construction shall, before shipment from the factory, be protected with a heavy coat of alkali resistant bituminous paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer. After the installation of doors/windows/partitions the lacquer shall be cleaned with warm water and soap and the aluminium members shall be resorted to their original matt finishes surface and colour.
5. All works shall be erected to plumb and true to line and ready for building into masonry, concrete or other type of wall construction. The side frame members and the top member shall be rigidly and securely screwed to concrete/masonry with adequate size of brass screws 100 mm long spaced at not more than 300 mm. All drilling of structural supports to install aluminium frames shall be done and included in the work. Wherever screw shall be used the same shall be of cadmium plated brass.
6. The contractor shall use electric drilling machine with suitable drill bit to make hole in masonry/ concrete. Any other method of fixing shall have prior approval of the Engineer. Maximum clearance between the frame and the masonry structures shall not be more than 1.25 cm. and shall smearing on the frame or on the wall. Vibration due to wind shall be arrested by way of providing suitable rubber packing, etc.
7. In general wherever applicable and unless otherwise noted the work shall conform to :  
IS : 1081-Fixing and glazing of metal (Steel & Aluminium) Doors, windows and ventilators.  
IS : 1948 - Specification for aluminium doors, windows and ventilators.  
IS : 1949 - Specification for aluminium doors, windows and Industrial buildings.
8. Care shall be taken to stack the materials properly to avoid distortion/damage to the fabricated item, after receipt at site. All fabricated items shall be packed and crated properly before despatch to ensure that there will be no damage to the fabricated material during loading and unloading operation to ensure safe arrival of materials at site.

9. The contractor shall supply and install all glass and glazing as required for doors, windows and partitions. All glass, shall be of superior quality from approved manufacturer like "Hindustan Pilkington" Modiguard or equivalent having uniform refractive index and free from flaws, specks, bubbles, distortion and waviness. In case of any defect is pointed out by the Engineer during the currency of contract and maintenance period, the contractor shall remove the same and replace it with new glass duly approved by the Engineer. Glass for the glazing and panelling purpose shall be as specified in the item. The cut edges of glass shall be round straight free from chips spell or any other damages. The contractor shall submit samples of glass for prior approval of the Engineer. Each glass panel shall be held in place by special glazing clips of approved type as specified in relevant IS code, adequate number of glazing clips as deemed necessary for holding the glass shall be provided. Glass panels shall be fixed with PVC/Neopring beading as mentioned in the drawing.

10. The measurement shall be taken for outer dimension of frame correct to centimeter and shall be payable in Sq.m.

11. The cost of locks, locking arrangements, floor type hydraulic door closer, floor spring, neopring stop/ PVC gasket, hinges, push plate/handle, spring catch, string hook, pivots, rollers, channels, plates, etc. shall be included in the unit rate quoted for doors. The rate shall include any chipping, braking and drilling apart into masonry/concrete surfaces required for fixing doors/windows/partitions, making good the surfaces to the original finish, dry packing sides, abutting the masonry/concrete with cement mortar 1:2 and sealing with mostic caulking compound to ensure perfect water tightness between the frames and walls. The rate shall also includes erection and dismantling of scaffolding for fixing at all elevations, all screws and M.S. members required for fixing door/window/partitions, cleaning etc. complete.

#### **ALUMINIUM DOORS :**

Door frames shall consist of member of size 63.45 x 38.10 x 1.95 mm. Door style shall be made out of aluminium member of size 85.00 x44.45x2.50 mm. Top, middle and bottom rail of size 114.30x44.45x2.50 mm shall be used for door shutter. For fixed glazed partition member of size 63.45x38.10x 1.95 mm shall have to be used. Frame members shall be fixed to concrete/masonry with adequate size of brass screws. 5.5 mm thick superior quality sheet glass shall be fixed on floor spring of Hardwin or equivalent approved make. Contractor has to show and take approval from Engineer before fixing the floor spring. If equivalent sections are permitted the weight per metre length shall match with above.

The cost of locks, locking arrangement, floor spring, neoprine stop/PVC gaskets, hinges, push plates/ handle, rubber beading, floor springs/door closers and all necessary fittings and fixtures required to fix the shutter shall be included in the unit rate quoted for the doors.

The cost of door shall also be include shutters in one or two parts are suitable at site. The contractor has to see the site/drawing before quoting the rates. Measurement shall be taken for outer dimension of frame correct to centimeter and shall be payable in sqm.

#### **FIXED ALUMINIUM WINDOWS :**

Window frames shall consist of member of size 63.45 x 38.10 x 1.95 mm. Window shall be in two or three parts as per drawings or as directed by the Engineer-in-Charge. Frame members shall be fixed to concrete or masonry with adequate size of brass screws. 4 mm thick superior quality sheet glass shall be fixed with glass clips and rubber headings. If equivalent sections are permitted the weight per metre length shall match with above.

The cost of glass clips, rubber headings and all necessary fittings and fixtures required to fix the windows shall be included in the unit rate quoted for the window.

#### **ALUMINIUM SLIDING WINDOWS**

Window frame shall consist of channel of size 61.85 x 31.75 x 1.50 mm. Sliding window shutters members of size 38.10 x 18.00 x 1.50 mm shall be used. If equivalent sections are permitted the weight per metre length shall match with above. Window shall be in two, three, or four parts as per drawing or as directed by Engineer-in-Charge. Frame member shall be fixed to concrete or masonry with adequate size of brass screws, 4 mm thick superior quality sheet glass shall be fixed with glass clips and rubber beading.

The cost of locking arrangement, heavy quality rollers, bearings, channels, neoprine stop/PVC gaskets, push plates/handle, rubber beading, and all necessary fittings and fixtures required to fix the window shutter shall be included in the unit rate quoted for the windows.

#### **ALUMINIUM PARTITIONS :**

Members of size 63.50 mm x 39.10 mm x 1.95 mm shall be used for all horizontal and vertical members of partitions. Bottom members shall be fixed tightly with floor by fixing 100 mm nails at 1 mtr. centres. Top horizontal members shall be tightly and securely fixed to bottom of slab or beam with adequate length of aluminium members of same size or as directed by the Engineer. If equivalent sections are permitted the weight per metre length shall match with above.

Specifications for materials viz. glass, partida boards, handles, nuts, washers, etc. and workmanship are similar as described for aluminium doors/windows.

#### **11. (A) A.C. SHEET FALSE CEILING**

11.1 The work covered by this specification shall consist of furnishing all labour, materials and equipment necessary for installation of the hung false ceiling with A.C. sheets consisting of anodised Aluminium Tee-Frame grid work with standard anodised Tee-section as main runner at 600 mm centres and aluminium special Tee as cross runners at 1200 mm centres. The main tees shall be hung from the RCC slab as shown in the drawing by 5 or 6 mm dia. M.S. suspenders threaded at one end attached to the main tees by holding cleats. The cross runner shall be screwed to the slots in the main tees with cleats. The frame work for A.C. sheet false ceiling shall be erected in rigid and substantial manner to proper level as indicated in the drawing. After preliminary fixing of the frame work it shall be aligned and levelled to the correct elevation by adjusting the nuts at the nuts at the threaded portion of suspenders. The plain A.C. sheet 4 mm thick shall be cut to size and placed between the frame work and fixed to the frame work with fastening clips including making openings for lighting fixtures, fans etc. all as shown in relevant drawings.

The anodised aluminium angles are to be fixed to the walls rigidly by means ofrawl plugs. The holes for fixing the aluminium angles are to be made by using drilling machine. No holes will be allowed to be made by using hammer and chisel.

The contractor shall take all necessary field measurements before fabrication of the framework for false ceiling so a to allow for the variation in dimensions between actual site measurement those that are indicated in drawings. The contractor shall at his own cost make good the damages to walls, floors etc. caused during the execution of work.

Mode of measurement shall be on square metre basis of the finished area.

#### **11.2. MODE OF MEASUREMENT**

The A.C. sheet false ceiling and masking shall be measured in square metres of the exposed area. Deduction shall be made for cutouts, lighting recesses etc. not covered by A.C. sheet.

#### **11. (B) SPECIFICATION FOR GYPSUM BOARD FALSE CEILING/MASKING**

The work covered by this specification shall consist of providing all labours, materials and equipments necessary for installation of the hung false ceiling/masking with gypsum board ceiling

system patented by M/ s. India Gypsum comprising of metal stud concealed frame work, ceiling channels (MF 6a & MF7) suspended by hanger rods (MF 8) fixed with anchor fasteners, 12.5 mm thick single layer Gyp board panels shall be fixed with channels by necessary screws/bolts. Strap hanger rods @ 1220 mm mak, centres to be suspended from RCC slab by drilling holes in ceiling and fixing anchor fasteners or welded cleat with E.P. in slab. The holes for fixing perimeter channels / strap hangers are to be made by using drilling machine. No holes will be allowed to be made by using hammer and chisel.

The frame work for false ceiling shall be erected in rigid and substantial manner to proper level as indicated in the drawing. After preliminary fixing of the frame work, it shall be aligned and levelled to the correct elevation.

The Gypsum board panels shall be cut to size and fixed to the frame work. The contractor has to make necessary arrangement for supply air/return air slit, lighting fixtures and any other opening required at site or as shown in relevant drawing.

Before fixing or placing of channels. Gypsum board panels etc., contractor shall take approval from the Engineer. If any defects found in materials after fixing, the contractor shall change the same and make good at his own cost to satisfaction of the Engineer.

The contractor shall take all necessary field measurements before fabrication of the frame work for false ceiling so as allow for the variation in dimensions between actual site measurement those that are indicated in drawing. The contractor shall at his own cost make good the damages to walls, floors etc. caused during the execution of the work.

#### **MODE OF MEASUREMENT:**

All broken, cracked or damaged glass, glass having weaviness colouring effect or any other flaws/defects shall be replaced by new one at contractor's cost.

### **11 (C) SPECIFICATION OF PLASOPAN PVC PARTITION DOORS, FALSE CEILING AND WALL PENELLING**

#### **DOUBLE WALLED PLASOPAN PANEL PARTITION**

Providing and fixing double wall plasopan PVC partition with hallow panels of size 150 x 10 mm. Fixed on both the sides of steel tube. The partition frame will be made of electric resistant welded semi-bright hollow steel tubes of 50 mm x 1.25 mm wall thickness and the four corners having radial of 2.4 mm to 4.88 mm. The vertical steel tubes members, duly welded to the horizontal member shall be placed between 1000 to 1200 mm apart and not more than 2 steel tubes will be used at any place for making a right angle or cross junction. The entire partition frame will be primed and painted with synthetic enamel paint. The infill inside the frame will be provided either entirely with plasopan panels placed horizontally as per the colour choice or partly with plasopan panels and partly with 4 mm plane sheet glass held in position screwed to the steel frame by means of (No. 6) self tapping steel screws placed at suitable intervals.

#### **SINGLE WALLED PLASOPAN PANEL PARTITION**

Providing and fixing single wall plasopan PVC partition with hallow panels of size 78 x 20 mm. The . partition frame will be made of electric resistant welded semi-bright hollow steel tubes of 50 mm x 25 mm x 1.25 mm wall thickness and the four comers having radial of 2.4 mm to 4.88 mm. The vertical steel tubes members, duly welded to the horizontal member shall be placed between 1000 to 1200 mm apart and not more than 2 steel tubes will be used at any place for making a right angle or cross junction. The entire partition frame will be primed and painted with synthetic enamel paint. The infill inside the frame will be provided either entirely with plasopan panels placed horizontally as per the colour choice or partly with plasopan panels and partly with 4 mm plane sheet glass held in position by means of plasopan angle 12 mm x 20 mm screwed to the steel frame on outer side and with plasopan

snapfit beading on inner side screwed to the steel frame by means of (No.6) self tapping steel screws placed at suitable intervals.

### **PLASOPAN PANEL DOORS**

Providing and fixing Plasopan PVC doors, single or double leaf with hollow panels of size 78 mm x 20 mm. The door shutter frame will be made of electric resistant welded semi-bright steel tubes of 40 mm x 25 mm and of 1.20 mm wall thickness.

M.S. Box of 150 mm x 40 mm of 18 gauge sheet will be fixed in the steel frame to act as a lock rail to house the mortice lock. The door will be held in position by means of 4 M.S. hinges per shutter. The steel frame of shutter will be filled with plasopan panels which will be held in position on the outer side with plasopan angles 12 mm to 20 mm screwed to the frame and M.S. Box and on the inner side with plasopan snapfit beading screwed to the frame work with (No.6) self tapping steel screws fixed at suitable intervals.

### **FITTINGS AND FIXTURES**

#### **A. FOR DOUBLE LEAF SHUTTER**

1.	250 mm long 16 mm dia Aluminium Aldrop	1 no.
2.	250 mm long Tower bolt	2 nos.
3.	Aluminium handle 100 mm long	4 nos.
4.	Aluminium flat latch	1 no.
5.	Aluminium Rubber buffer	2 nos.
6.	Aluminium Door stopper	2 nos.
7.	Door Closure	1 no

(Supplied by Department free of cost)

#### **B. FOR SINGLE LEAF SHUTTER**

1.	250 mm long 16 mm dia Aluminium Aldrop	1 no.
2.	250 mm long Tower bolt	1 nos.
3.	Aluminium handle 100 mm long	2 nos.
4.	Aluminium flat latch	1 no.
5.	Aluminium Rubber buffer	1 nos.
6.	Aluminium Door stopper	1 nos.

(Supplied by Department free of cost)

7.	Door Closure	1 no
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### **12. WATERPROOFING TREATMENTS**

All the waterproofing treatments included in the schedule of quantities shall be covered by a guarantee for leakproof performance for a period of ten years from the date of completion of the building and the guarantee certificate shall be submitted before the final bill is paid.

## **12.1 INDIA WATERPROOFING OVER TERRACES**

**12.1.1** Waterproofing shall be as specified in the schedule of items. All proprietary material shall be laid to manufacturer's specifications and the contractor shall issue to the Department a guarantee certificate for ten years from the date of completion of the building and shall be submitted before the final bill is paid.

**12.1.2** The R.C.C. slab should be cleaned of all unwanted materials and the surfaces made rough. The construction joints or cracks if any should be inspected and if found necessary "Damp Proof compound with cement solution as per manufacturer's specifications shall be injected to seal off the honeycombs and cavities in the slab, which shall then be subjected to terrace method of waterproofing treatment as per manufacturer's specifications. The cleaned terrace shall be watered properly and cement slurry shall be spread over the slab and brick bat coba in "Damp Proof cement mortar shall be laid to provide necessary gradient for easy flow of rain water. The coba shall be laid in a special manner with brick bats partly projected above. The brick bat joints shall be filled in with "Damp Proof jointless waterproof plaster finished smooth with trowel in thin layer of cement and marked into 300 mm x 300 mm false squares or left smooth if directed by the Engineer. This treatment shall be continued along the inner sides of parapets or adjoining walls upto a height of 300 mm to 375 mm in the shape of round vata. While the finish is still green a coat of Geru (red coloured fine powder) shall be applied as a very thin layer. The construction joints shall be taken at ridges and should be made properly watertight and monolithic. Brick bat coba shall be of average thickness of 150 mm or as specified in the drawings or as directed by the Engineer. Care shall be taken to finish the rain water inlets etc. properly so that no leakage occurs. The terrace shall be tested for watertightness after the treatment is completed and any defects shall be made good.

### **12.1.3 MODE OF MEASUREMENT**

The measurements shall be for the superficial area covered by the treatment. The length and breadth shall be measured along the vata including the height of vatas of finished exposed surface. Area of all openings, cutouts, pipe crossing etc. shall be deducted.

## **13. BRICK BAT COBA**

**13.1** After the expiry of the curing period of R.C.C. slab, the surfaces shall be brushed and cleaned of all dust and foreign matter to lay brick bat. The brick bat coba shall be laid and consolidated to proper slopes as directed by the Engineer to facilitate easy drainage of storm water and shall be of average thickness as specified in the item. The specifications for the materials laying and curing etc. of this concrete shall be as specified in IS :3038.

Consolidation shall be done on next day by beating the surface with wooden beaters and shall continue on subsequent days till brick bat coba is properly consolidated and beaters rebound and do not make any impression on the surface. During process of beating, the surface shall be constantly kept wet by sprinkling water.

### **13.2 MEASUREMENT**

The measurements shall be taken of the surface area multiplied by the average thickness and this shall include vatas at junctions between roofs and parapet.

## **14. RENDERING THE ROOF SLAB**

**14.1** The specification of the cement, sand and water as stated in the specification for R.C.C. concrete will also hold good for this work.

**14.2** The brick bat coba which is already laid in the roof slab in the slopes shall be thoroughly cleaned and wetted. All uneven projections shall be knocked off. The plaster of 1:4 mix and of specified thickness is then applied over the prepared surface and worked evenly to uniform thickness by means of long straight edges. The surface of the plaster shall be finished smooth by trowels. The plaster shall be kept wet constantly for 10 days. All the corners and edges shall be finished smoothly. The rate of the brick bat coba shall be inclusive of the rendering cost and no extra on this account shall be paid.

### **14.3 MEASUREMENT**

Surface area covered shall be measured for payment deducting all openings, pipe crossing etc.

## **15. MISCELLANEOUS ITEMS**

### **15.1 ALUMINIUM LADDER**

**15.1.1. Scope :** This specification covers the works of providing and fixing aluminium ladders.

**15.1.2** The alloy used in the manufacture of the extruded section for ladder shall correspond to I.S.: 733-1956. All the aluminium section shall be 'Indal/JindaP or equivalent make as specified in the detailed drawings. The sections shall be true in shape and size without any defects such as air holes, cracks, scratches etc. The sections shall have white anodised, matt finish with natural lusture on the surface and they shall have smooth bends without any dents or impressions visible on the surface and all the edges shall be properly trimmed. The shop and site connection shall be highly skillful and produced in the least workmanship manner, particularly the reveted work shall be smooth and uniform without damaging any of the members. The bracket shall be of cast aluminium free from air holes, cracks, scratches and other casting defects and shall have white anodised matt finish. The aluminium bracket shall be fixed to the RCC or brick work with proper necessary chasing and grouted in cement mortar 1:2 at approved locations as directed. Other connection shall be done with brass cadmium plated machine screws, bolts and nuts as shown in the drawing. The erection of the ladder should be done in a skillful manner with the experienced tradesmen and shall be erected in proper alignment as shown in the drawing. All precaution and safety means shall be done while erection of the ladder.

**15.1.3** The mode of payment for the ladder shall be per metre basis of the finished ladder in position, and if no item exists, it may be paid on weight basis.

### **15.2 RAILING**

**15.2.1** The teak wood hand railing and the M.S. balusters shall be fixed in position to true line and inclination in the best workmanlike manner as per details shown in the drawing.

**15.2.2** The M.S. plate inserts shall be embedded in every step forming a pocket. The M.S. baluster shall be welded to the plate embedment and the pocket shall then be grouted in cement mortar 1:3 and finished smooth. The M.S. flat shall be welded at the top of balusters to the proper inclination and all welds shall be ground flush as directed by the Engineer. A teak wood hand rail of specified size shall be screwed to the M.S. flat or angle as per detailed drawing. The specification for teak wood for hand rail shall be similar to woodwork cover under wooden doors. The timber shall be of best quality C.P. teak wood as specified and be moulded to correct shapes and dimensions shown in the drawings and in best workman like manner. The hand rails both steel and woodwork shall be painted with one coat at approved primer. Alternatively teak wood railing may be replaced by PVC 2 mm thick. In such case structural steel and PVC shall be measured separately and paid for.

**15.2.3 MEASUREMENT :** The rates quoted for hand rails shall be as per running metre of complete hand railing including balusters railing. M.S. plate inserts, fittings etc. Measurements will be taken along the length of the top hand rail only. Alternatively teak wood railing may be replaced by PVC 2 mm thick. In such case structural steel and PVC shall be measured separately and paid for.

### **15.3 CHAIN LINK FENCING**



Chain link wire netting will be fixed on M.S. angles with the help of suitable bolts, nuts, washers and G.I. wire rod. Chain link will be embedded into the coping concrete as per the details shown in the drawing. Entire steel works inclusive of M.S. angles, G.I. netting will be painted as specified in the item.

Contractors rate for this item includes all labour and cost of M.S. angles, bolts and washers, nuts, clips and wire rods those required for fixing the fencing. Contractors rate will also include cost of painting all steel work with two coats of paint including one primer and one finishing coat.

R.R. Masonry dwarf wall and cement concrete coping of the same only will be measured and paid separately in relevant items. Unit of measurement will be running length of completed fencing.

#### **15.4 M.S. GATE**

M.S. gate will be manufactured out of M.S. pipe (medium range) of specified diameter as per size and shape indicated in the drawings. The gate will be suitably strengthened with M.S. angles/M.S. flats, if required.

The rate also includes painting the steel work with two coats of paint of approved make and shade over a coat of red oxide primer. Necessary excavation and concrete required for embedding the outer frame etc. will not be measured separately and rate includes the cost of the same.

Unit of measurement will be in area basis. Area of gate will be worked out from product of gate outside to outside of channel fixed as outer frame and height of gate measured vertically from bottom of bottom pipe to top of top pipe.

#### **15.5 SHAHABAD STONE CLADDING**

The shahabad stones shall have chisel dressed outer edges and shall be 25 to 50 mm thick and 600 mm to 1200 mm long and 100 mm average width. The surface preparation shall be similar to the rough cast plaster./ Shahabad stones shall be laid lengthwise on the bed of cement mortar 1:4. The horizontal and vertical mortar joints shall be 20 mm to 25 mm thick. The stones shall be laid with broken vertical joints has shown in the drawings and as directed by the Engineer. All joints shall be sunk pointed with cement mortar 1:4 to the required depth finished to line, level plane and plumb as shown in the drawing. The surface will be cured for at least 7 days. Due care shall be taken to provide a chase in the brick wall at an interval of 500 mm for the entire course to provide adequate anchorage in the brick wall. This stratified shahabad stones cladding work shall be carried out as per approved patterns with random projections of stones (4 or 5 per sq.m.) 25 mm beyond the general surface and as directed by the Engineer. Samples shall be prepared and contractor shall obtain approval of the Engineer before proceeding with the work.

The measurement shall be for the superficial area, the unit being one square metre. The length & height shall be measured to nearest centimetre.

#### **15.6 PRECAST R.C.C. JALLI**

The sample of precast RCC jalli of thickness 50 mm or as specified in item shall be of best quality obtained from approved manufactures. Samples of different pattern shall be first submitted to the Engineer and got approved by him prior to placing the order of bulk supply. All Jalli which go into the work shall strictly conform to the sample approved by the Engineer failing which the entire materials are likely to be rejected.

The jalli shall be set in position, true to plumb and level before the jambs, sills and soffits of the openings are plastered.

# **SPECIFICATION FOR PAINTING ETC**

## **1. SCOPE OF WORK:**

The work covered under these specifications consists of furnishing the various types of paints and also the workmanship for those items, strict compliance of these specifications, is in addition to details which are given in the respective item of schedule of quantities.

## **2. GENERAL:**

### **2.1. MATERIALS:**

**2.1.1** Paints shall be ready mixed unless otherwise specified except that any coating in paste or powder form shall be field mixed in accordance with direction of the manufacturers. The paint shall have good flowing and brushing properties and shall dry to a smooth, plain film, free of streaks or sags. No thinner or other materials shall be added to the paint without the consent of the Engineer. If any reason, thinning is necessary in case of ready mixed paint, the brand of thinner recommended by the manufacturer or as instructed by the Engineer shall be used.

**2.1.2** Materials shall be of highest grade products of well known approved manufacturers and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade with labels intact and seals unbroken. All materials shall be subject to inspection, approval by Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint of one shade be obtained from the same manufacturing batch. All paint shall be subject to an analysis from random samples taken at site from painter's bucket, if so desired by the Engineer. Colour shall be uniform and non-fading.

**2.1.3** All prime coats shall be compatible to the material of the surface to be finished as well to the finishing coats to be applied.

**2.1.4** All unspecified materials such as Shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the relevant and latest I.S. standard.

All such materials shall be made by reputable recognised manufacturers and shall be approved by the Engineer.

**2.1.5** All colours shall be as per painting schedule and timing and matching shall be done to the satisfaction of the Engineer. In such cases where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.

**2.1.6** The contractor shall arrange for safe and proper storage of all materials and tools. Paints shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent damage from and/or any other cause. The empties shall not be removed from the site or work, till the relevant item of work has been completed and permission obtained from the Engineer.

## **3. COMMENCING WORK**

Painting shall not be started until and unless the Engineer has inspected the items of work to be painted, satisfied himself about their proper quality and given his approval to commence the painting work.

Painting, except the priming coat, shall generally be taken in hand after all other contractor's work practically finished.

The rooms should be thoroughly swept out and the entire building cleaned up, at least one day in advance of the paint work being started.

#### **4. PREPARATION OF SURFACES :**

**4.1** The surfaces requiring painting shall be thoroughly cleaned of all dirt, dust, grease or oil before spotting or priming. The surface shall be sandpapered and/or rubbed with emery cloth, if necessary to remove grease mortar or any other foreign materials. Oil or grease film shall be washed off with an acid that is non-injurious to the surface or shop primer and rinsed off completely with plain or scapy water. Surface shall be dry unless dampening is required for a particular finished materials. In case of rusted surface, it shall be first cleaned with steel wire brushes till the corroded crust is removed. The prepared surfaces shall be shiny and free from brush marks, patches, blisters and other irregularities. Before starting the work, the contractor shall obtain the approval of the Engineer regarding the soundness and readiness of the surface to be painted on.

**4.2** Masonry, concrete and plastered surfaces shall be free from oil, grease, efflorescence, mildew, loose paint or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface, the surfaces area shall be treated with minimum one coat of cement primer which should be continued to the surrounding area for a distance of 100 mm.

Surface with mildew or efflorescence shall be treated as below :

**4.2.1. Mildew :** All mildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7.0 gm. of copper carbonate dissolved in 80 ml. liquor ammonia and silicofluride solution and allowed to dry thoroughly before paint is applied.

**4.2.2. Efforoscence :** All efflorescence shall be removed by scrubbing affected surfaces with a solution of muriatic acid in water (1:6 to 1:8) and washed fully with clean water and' allow to dry before application o fsealer of other paints.

**4.3** All metal surface shall be absolutely clean, dry and free from wax, greased or dried soap films. All steel and iron surfaces in addition shall be free from rust. All galvanised surfaces shall be pretreated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coats shall be touched up with the same quality of paint as the original coat. The cleaning and operation of priming paint at site shall be carried out after the erection of steel.

**4.4** All wooden surfaces shall be thoroughly planed and sandpapered. In case the surface having knots, nail holes, they shall be filled with stopping and knotting materials. The knotting materials shall consists of pure shellac dissolved in methylated spirit. For stopping Russian tallow or putty shall be used, the later should consist of two parts of whiting (powdered chalk), one part of white lead mixed together in double boiled linseed oil and wellknealed. The surface thus treated shall be allowed to dry up and then sandpapered. Alternatively a ready made approved putty may be used.

In all cases the following procedure will be followed, after preparing the surface, a primer coat shall be applied. After this an under coat shall be given. Thereafter a top coat shall be applied. This may also be the finishing coat but if the surface is not satisfactory or if a particular kind of paint require an additional finishing coat, this shall be given. Each successive coat shall be applied after the previous one is dry. Care should be taken that dust or other foreign materials do not settle or otherwise disfigure the various coats.

All the preservatives shall be of approved brand or a specified in the schedule. They should be procured in sealed tins and stocked at site. As stated in the specification as above but stout brush shall be used. The preservative should also be applied profusely at the ends and allowed to soak well. The first coat shall be allowed to soak before the successive one is rendered. The process shall be done in minimum three coats.

#### **5. APPLICATION:**

**5.1** Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its containers.

when applying also the paint shall be continuously stirred in the smaller containers so that consistency is kept uniform.

**5.2** The painting shall be laid evenly and smoothly by means of crossing and laying off, the latter in the direction of the grains of wood. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time and then brushing alternatively in opposite directions two or three times and then brushing alternatively in opposite directions two or three times and then finally brushing lightly in direction at right angles to the same. In this process, no brushmarks shall be left after the laying off is finished. The full process of crossing and laying off will constitute the coat. Second coat means next layer laid after setting of first coat, rubbed smooth and then applied coat.

**5.3** Where so stipulated the painting shall be done with spray machine used may be (a) high pressure (small air aperture) type of (b) a low pressure (large air gape) type, depending on the nature and location of work to be carried out. Skilled and experienced workman shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner. Spraying should be done only when dry condition prevails.

**5.4** Each coat shall be allowed to dry out thoroughly and rubbed smooth before the next coat is applied. This should be facilitated by through ventilation.

**5.5** Each coat except the last coat, shall be lightly rubbed down with sand paper or fine pumice stone and cleaned of dust before the next coat is laid.

**5.6** No left over paint shall be put back into the stock tins. When not in use, containers shall be kept properly closed.

**5.7** No hair marks from the brush or clogging of paint puddles in the comers of panels, angles of moulding etc., shall be left on the work.

**5.8** In painting doors and windows, the putty round the glass panes must also be painted; but care must be taken to see that no paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out while painting. Prospect covers of electrical switch boxes have to be painted from inside by removing them. Care shall be taken while removing them and placing them in position after painting with respective approved paints. In painting steel work, special care shall be taken while painting over bolts, nuts, rivets, overlaps etc.

**5.9** The additional specifications for primer and other coats of paints shall be as according to the detailed specifications under the respective headings.

#### **5.10 Brushes and Containers**

After work, the brushes shall be completely cleaned of paint and linseed oil by rinsing with turpentine. A brush in which paint has dried up ruined, shall on no account be used for painting work. The containers, when not in use, shall be closed, kept air tight and shall be kept at a place free from dust. When the paint has been used. The containers shall be washed with turpentine and wiped dry with soft clean cloth, so that they are clean and can be used again. ^.

### **6. PAINTING : PRIMING COAT ON WOOD, IRON OR PLASTERED SURFACES**

#### **6.1 MATERIALS:**

**6.1.1** The priming coat for wood work, iron work or plastered surface shall be as specified in the description of the item.

**6.1.2** The priming coat shall be prepared at site, or ready made paint of approved brand and manufacturer.

**6.1.3** Where primer for wood work is to be mixed at site, it shall be prepared from a mixture of red lead, white lead and double boiled linseed oil in the ratio of 0.71 kg.: 0.71 kg : 1 litre.

**6.1.4** Where primer for steel work is to be mixed at site, it shall be prepared from mixture of red lead, rawlin seed oil and turpentine in the ration 2.84 kg : 1 litre : 1 litre.

**6.1.5** The specifications for the base, vehicle and thinner for mixed on site primers shall be as follows :

(i) White lead : The white lead shall be pure and free from adulterants like barium sulphate and whiting. It shall conform to I.S. : 103 - 1950 as amended from time to time.

(ii) Red lead : This shall be in powder form and shall be pure and free from adulterants lime brick dust etc. It shall conform to I.S. : 102 - 1950 as amended from time to time.

(iii) Raw linseed oil: Raw linseed oil shall be lightly viscous but clear and of yellowish colour with slight brown tinge. Its specific gravity at a temperature of 30°C(80°F) shall be between 0.925 and 0.928. The oil shall be yellow and sweet to the taste with very little smell. The oil shall be sufficiently matured quality. Oil, turbid or thick, with acid and bitter taste and rancid odour and which remain sticky for a considerable time shall be reheated. The oil shall conform in all respects to I.S.: 75 - 1950 as amended from time to time. The oil shall be of approved brand and manufacturer.

(iv) Double boiled linseed oil: This shall be more viscous than the raw oil, have a deeper colour and specification. It shall dry with a glossy surface. It shall conform in all respects to I.S.: 77 - 1950 as amended from time to time. The oil shall be of approved brand and manufacturer.

(v) Turpentine: Mineral turpentine i.e. petroleum distillate which has the same rate of evaporation as vegetable turpentine (distillate produce of oleoresin of conifers) shall be used. It shall leave no grease or other residue when allowed to evaporate. It shall conform to I.S.: 83 - 1950 as amended from time to time.

**6.1.6. French or spirit polishing :** Polish shall be obtained by dissolving 150 gms of shellac in 1 litre of methylated spirit without applying any source of heat. After the shellac has dissolved 227 gms. of copal (Chandras), 114 gms. of lebana(Mogali bedani)and 11.3 gms of crystals of desired pigment shall be added e.g. Mahogany, Light chrome as specified.

**6.1.7** All the above materials shall be of approved manufacture and brought to site in their original packings in sealed conditions.

## **6.2. PREPARATION OF SURFACE :**

**6.2.1** The wood work to be painted shall be dry and free from moisture.

The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any shall be covered with a preparation of red lead made by grinding red lead in water and mixing with strong glue size and used hot.

The surface treated for knotting shall be dry before painting is applied. After the priming coat is applied the holes and indentations on the surface shall be stopped with glazier's putty or wood putty. Putty shall be prepared by mixing one part of white lead and three parts of finely powdered chalk powdered chalk and then adding boiled linseed oil to the mixture to form into a stiff paste. Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in the stopping and the latter is therefore liable to crack.

**6.2.2** Iron and Steel work : All rust and scales shall be removed by scraping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes

loose by rusting shall be removed. All dust and dirt shall be thoroughly wiped away from the surface. If the surface is wet, it shall be dried before priming coat is undertaken.

**6.2.3** Plastered surface: The surface shall ordinarily not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and when drying is satisfactory, painting shall be taken in hand. Before primer is applied, holes and undulations shall be filled up with plaster of Paris and rubbed smooth.

**6.3 APPLICATION:**

The primer shall be applied with brushes, worked well into the surface and spread even and smooth. The painting shall be done by crossing and laying off as described in para 5.

**6.4 OTHER DETAILS :**

The specifications for "Painting (General)" in para 2 shall hold good in so far as they are applicable.

**7. PAINTING WITH SUPERIOR QUALITY FLAT OIL READY MIXED PAINT :**

**7.1 PAINT:**

Ordinary quality or superior quality ready mixed paints as specified in the item shall be of approved brand and manufacturer and of the required shades. The same shall conform in all respect to the relevant I.S. specification.

**7.2 PREPARATION OF SURFACES :**

**7.2.1.** Wood Work : The surface shall be cleaned and all unevenness removed. Knots if visible, shall be covered with a preparation of red lead. Holes and intentions-on the surface shall be filled in with glazier's or approved wood putty and rubbed smooth before painting is done. The surface should be thoroughly dry before painting.

**7.2.2** Iron and steel work : The priming coat shall have dried up completely before painting is started. Rust and scaling shall be carefully removed by scraping or by brushing with steel wire brushes. All dust and dirt shall be carefully and thoroughly wiped away.

**7.2.3** Plastered surface : The priming coat shall have dried up completely before painting is started. All dust or dirt that has settled on the priming coat shall be thoroughly wiped away before painting is started. This surface should be well dried before painting.

**7.3 APPLICATION:**

The specifications in sub-para 6.2.3. shall hold good as far as applicable.

The number of coats to be applied will be as stipulated in the item. The painted surface shall present a uniform appearance and glossy/semi glossy finish, as the case may be and free from streaks, blisters etc.

**7.4 OTHER DETAILS:**

The specifications for "Painting (General)" in para 2 shall hold good in so far as applicable.

**8. PAINTING WITH SYNTHETIC ENAMEL PAINT/SEMI GLOSSY PAINTING WITH SYNTHETIC ENAMEL PAINT ON NEW WORK.**

**8.1** Paint: Synthetic enamel/semi glossy paint of approved brand manufacture and of the required shade shall be used for the top coat and an undercoat of shade to match the top coat as recommended

by the manufacture shall be used. Synthetic enamel paint shall be made from synthetic resins and braying oil with rutile titanium dioxide and selected pigments to give a smooth, hard, durable and glossy finish to all exterior and interior surfaces. White and pasted shades shall resist yellowing and darkening with aging. The paint shall conform to IS : 2932 and IS : 2933.

**8.2 PREPARATION OF SURFACE :** This shall be as for painting with ordinary or superior quality ready mixed paint in para 6.2.1 of 6.2.2 as the case may be.

**8.3 APPLICATION :** The number of coats including the undercoat shall be as stipulated in the item.

**8.3.1 Undercoat:** One coat of the specified paint of shade suited to the shade of the top shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface free from brush marks and all loose particles dusted off. All the cracks, crevices, roughness etc. will be filled with approved putty as per manufacturer's recommendations.

**8.3.2 Top coat:** Finishing coats of specified paint of the desired shade shall be applied after the undercoat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure a properly uniform semi glossy surface.

**8.4 OTHER DETAILS :** The specifications for "Painting (General)" in para 2 shall hold good as far as they are applicable.

**9. MEASUREMENTS :**

**9.1** Painting except where otherwise stated, shall be measured in square metre. Length and breadth shall be measured correct upto 0.01 meter and areas shall be worked out to the nearest 0.01 sqm. No deduction shall be made for openings not exceeding 0.5 sqm each and no addition shall be made for painting to beading, moulding, edges, jambs, soffits, sills etc., of such openings. Painting on different types of work shall be kept separate and surfaces to be painted shall be described. It shall be stated whether measurements are flat or girthed. Alternatively, different surfaces may be grouped into one general item, areas of uneven surfaces being converted into equivalent plain areas in accordance with Table 1. As for as walls are concerned the rules for deductions etc. as applicable for plastering work shall be generally followed

**TABLE-1**

<b>Sr. No.</b>	<b>Description of work</b>	<b>How measured</b>	<b>Multiplying Factor</b>
1.	Panelled or framed and braced or ledged or battered doors & windows of wooden	Measured flat (not girthed) including chowkhat or frame. Edges, architraves etc. shall be deemed to be included in the item.	1.30 (for each side)
2.	Flush doors and windows of wooden	Measured flat (not girthed) including chowkhat or frame. Edges, architraves etc. shall be deemed to be included in the item.	1.20 (for each side)
3.	Fully glazed or gauzed doors and windows of wooden	Measured flat (not girthed) including chowkhat or frame. Edges, architraves etc. shall be deemed to be included in the item.	0.80 (for each side)

4.	Partially panelled and partly glazed or gauzed doors and windows of wooden	Measured flat (not girthed including chowkhat or frame. Edges, architraves etc. shall be deemed to be included in the item.	1.00 (for each side)
5.	Fully ventilated or louvered glazed or gauzed doors and windows of wooden	Measured flat (not girthed) including chowkhat or frame. Edges, architraves etc. shall be deemed to be included in the item.	1.80 (for each side)
6.	Guard bars, balustrads, gates, gratings. Gills, railing	Measured flat overall; no deduction shall be made for open spaces; supporting members shall not be measured separately.	1.00 (for painting all over)
7.	Gates and fencing including grating. Grills, railing	Measured flat overall; no deduction shall be made for open spaces; supporting members shall not be measured separately.	1.00 (for painting all over)
8.	Steel rolling shutter	Measured flat (size jot opening) overall; jamb, guides, bottom rails & locking arrangement etc. shall be included in the item.	1.10 (for each side)
9.	Plain sheet steel doors and windows, metallic flush doors	Measured flat (not girthed) including frame, edges etc.	1.10 (for each side)
10.	Fully glazed or gauzed steel doors and windows without guard bars	Measured flat (not girthed) including frame, edges etc.	0.50 (for each side)
11.	Partly panelled and partly glazed or gauzed steel doors all without guard bars/mesh	Measured flat (not girthed) including frame, edges etc.	0.80 (for each side)
12.	Steel windows with guard bars	Measured flat (not girthed) including frame, edges etc.	1.00 (for each side)
13.	Others	Refer I.S. Code	-

## 9.2 EXPLANATORY NOTES ON THE TABLE OF COEFFICIENT

**9.2.1** Where doors, windows etc. are of composite types other than those included in table, the different portion shall measure separately with their appropriate coefficients the centre line of the common rail being taken as the dividing line between the two portions.

**9.2.2** The measurements for doors, windows, etc. shall be taken flat (and not girthed ) overall including chowkats or frames, architraves etc., wherever provided. Where chowkats or frames are not provided, the shutter measurements shall be taken.

**9.2.3** The coefficient for doors and windows shall apply irrespective of the sizes of frames, architraves and shutter members.

**9.2.4** When the two faces of a door, windows etc., are to be treated with different specified finishes, measurable under separate items, the edges of frames and shutters shall be treated with the one or other types of finish as ordered by Engineer and measurement of this will be deemed to be included in the measurement of the face treated with that finish.



**9.2.5** In case where shutters are fixed on both faces of a frame, measurement for the door frame and shutter on one face shall be taken in the manner already described, while the additional shutter on the other face shall be measured exclusive of the frame.

**9.2.6** Where shutter are provided with clearance at top and/or at bottom, such openings shall be deducted from the overall measurement and relevant coefficient applied.

**9.2.7** Measurement of painting of doors, windows, rolling shutters etc. as given in the above table shall be deemed to include painting, if required, of all iron fittings in the same shade.

**9.2.8** Wherever air-conditioning grills, lighting fixtures etc. in false ceiling are painted along with measurements shall be taken overall without deductions for opening in grills and no extra shall be paid for the grills. If grills, fixtures, etc., are not painted, area of fixtures or grills as measured flat (not girthed) shall be deducted when it exceeds 0.5 sq.m. individually. Where walls and ceilings are painted in separate colours, the junctions of two paints shall be brought down on the walls in a straight line by about 6 mm to 12 mm, if so desired, if the junctions of walls and ceilings are not even. No extra shall be paid to the contractor on this account. Beading wherever provided shall not be measured separately but shall be deemed to be included in the area of false ceiling.

**9.2.9** For trusses, compound girders, stanchion as lattice girders and similar work, actual areas will be measured in sq.m., and no extra shall be paid for painting on bolt heads, nuts, washers, etc. even when they are picked out in a different tint to the adjacent work.

**9.2.10** In case the items of works requiring painting are inclusive of cost of painting carried out shall not be measured separately.

**9.2.11** Corrugated sheet surfaces shall be included with plain surfaces after increasing their areas by the following percentages.

a.	Corrugated G.I. sheets	:	14 percent
b.	Asbestos Cement sheets, corrugated	:	20 percent
c.	Asbestos cement sheets, semi corrugated	:	10 percent

## **10 PAINTING WITH ACRYLIC EMULSION PAINT/PLASTIC EMULSION PAINT**

**10.1** This shall be polyvinyl based Acrylic emulsion paint manufactured by one of the reputed paint manufacturers and despatched to the site in sealed containers.

### **10.2 PRIMER:**

A primer to be used for the painting with acrylic emulsion on cement concrete and plaster and plastered surfaces, A.C. sheets as also timber and metal surfaces (if necessary) shall be of approved base and as per recommendations of the manufacturers.

### **10.3 PUTTY:**

Paste filler to be used for filling up (puttying uneven surfaces, small cracks and holes etc. shall be of approved compound and as per recommendations of the manufacturers. No oil based putty shall be used. The putty should be made from a mixture of whiting and plastic emulsion paint or as per manufacturer's recommendations.

### **10.4 FINISHING COATS :**

All the finishing coats shall be of matt finish or any other finish required by the Engineer. Number of finishing coats shall be as specified in the item.

## **10.5 MEASUREMENTS:**

All the measurements of payment shall be taken on net surface areas actually painted, unless otherwise specified. Deduction will be made from the areas for fixtures, grills, ventilation outlets, electrical boxes and such obstruction not painted, if they are individually more than 0.05 sq.m.

## **11 JOB REQUIREMENTS :**

NOTE : PAINTING OF PLASTERED SURFACE :

- i) Acrylic emulsion paint is required to be provided on plastered and concrete surfaces in portions of the building. It may please be noted that department shall reserve the option to delete or increase quantities in full or part from the scope of contract during progress of work.
- ii) All wood surfaces are to be painted with semi glossy synthetic enamel paint with an approved primer. Primer of zinc chromate primer.
- iii) Zinc chromate primer supersedes wood primer mentioned earlier in the specifications.
- iv) All colours of paints shall be subjected to review and prior approved of Engineer shall be taken before the application

## **12 WHITE WASHING WITH LIME :**

### **12.1 SCAFFOLDING:**

Wherever scaffolding is necessary, it shall be erected on double supports tied together by horizontal pieces, over which scaffolding planks shall be fixed. No ballies, bamboos or planks shall rest on or touch the surface which is being white washed. Where ladders are used, pieces of old gunny bags shall be tied on their tops to avoid damage or scratches to walls. For white washing the ceiling, proper stage scaffolding shall be created.

### **12.2 PREPARATION OF SURFACE :**

Before new work is white washed, the surface shall be thoroughly cleaned of mortar dropping and other stickings. All loose scales and flakes shall be removed by rubbing with Hessian cloth or sandpapering. All holes shall be filled and the surface rubbed smooth to get evenness with the existing surface.

In the case of old work, all loose pieces and scales shall be scrapped off and holes in plaster as well as patches of less than 50 sq.cm. area shall be filled up with mortar of the same mix. Where so specifically ordered by the Engineer, the entire surface of old white wash shall be thoroughly removed by scrapping.

### **12.3 PREPARATION OF LIME WASH :**

White washing shall be done with lime solution. Lime shall be fat lime, clean and absolutely white. The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. It should be first made into putty and then mixed with water to make solution and be shifted through a fine double folded muslin cloth. 4 kg. of gum dissolved in hot water, shall be added to each 1 cubic meter of the lime putty. The approximate quantity of water to be added in making the cream will be 5 liters of water to one kg. of lime.

Indigo (Neel) up to 3 gm. per kg. of lime dissolved in water, shall then be added and wash stirred well. Water shall then be added at the rate of about 5 liter per kg. of lime to produce a milky solution.

### **12.4 WHITEWASHING:**

The white wash shall be applied with brushes or by spray in the specified number of coats. The operation for each coat in case of brush application shall consist of a stroke of the brush given from the top downwards, another from the left before it dries.

Each coat shall be allowed to dry before the next one is applied. Further each coat shall be inspected and approved by the Engineer before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on.

For new work, three or more coats shall be applied till the surface present a smooth and uniform finish through which the plaster does not show. The finished dry surface shall not show any signs of cracking and peeling. It should not come off when rubbed hard with hand.

For old work, after the surface has been prepared as described in para 2 of 12.2 a coat of white wash shall be applied over the patches and repairs. Then a single coat or two or more coats of white wash as stipulated in the description of the item shall be applied over the entire surface. The white washed surface should present a uniform finish through which the plaster patched do not appear.

### **13 COLOUR WASHING :**

In case of colour washing, mineral colours, not affected by lime shall be added to white wash with proper glue. No colour wash shall be done until a sample of colour wash to the required tint or shade has been got approved from the Engineer. The colour shall be of even tint or shade over the whole surface. If it is patchy or otherwise badly applied, it shall be redone by the contractor at his/their own cost.

For new work. the priming coat shall be of white wash with lime or with whiting as specified in the description of the item. Two or more coats shall be applied on the entire surface till it presents a smooth and uniform finish. Each coat after applying shall be got approved from the Engineer. The finished dry surface shall not readily come off on the hand when rubbed. Other specifications will be as detailed for white washing. Indigo (neel) shall however, not be added.

### **14. DRY DISTEMPERING:**

#### **14.1 DISTEMPER:**

Dry distemper of approved brand/manufacture and colour and required shade shall be used. The dry distemper shall be stirred slowly in clean water using 0.6 liters of water per kg. of distemper or as specified by manufacturers. Warm water shall preferably be used. It shall be allowed to stand for at least 30 minutes before use. The mixture shall be invariably well stirred before and during use to maintain an even consistency.

#### **14.2 PREPARATION OF SURFACE :**

The surface shall be prepared as per procedure in white washing.

#### **14.3 APPLICATION:**

In case of new work, the treatment shall consist of a priming coat followed by the application of two or more coats of distemper till the surface shows an even colour.

#### **14.4 PRIMING COAT :**

Priming coat of whiting shall be applied over the prepared surfaces. Priming coat shall be applied with whiting which shall be dissolved in sufficient quantity of water and thoroughly stirred to form a thin slurry which shall then be screened through a clean coarse cloth. Two kgs. of gum and 0.4 kg. of copper sulphate dissolved separately in hot water shall be added for every cu.m. of the slurry

which shall then be diluted with water to the consistency of milk so as to make wash ready for use. No white washing coat shall be used as a priming coat for distemper.

**14.5** The application of each coat shall be as mentioned in the specifications for white washing in 12.4 shall hold good as far as they are applicable.

## **15. OIL BOUND DISTEMPER :**

**15.1** Oil bound distemper of approved brand/manufacture and colour and required shade shall be used. The primer where used as on new work shall be cement primer or distemper primer as specified in the item. These shall be of the same manufacture as oil bound distemper.

**15.2 PREPARATION OF SURFACES :** Priming coat with cement primer or distemper primer shall only be applied.

**15.3 APPLICATION :** The cement primer or distemper primer shall be applied by brushing and not by spraying. Hurried priming shall be avoided, particularly on absorbent surfaces. New plaster patches in old work before applying oil bound distemper shall be treated with cement primer/distemper primer. The surfaces shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours before oil bound distemper is applied. Before applying distemper, the surface shall be lightly sand papered to make it smooth for receiving the oil bound distemper, taking care not to rub out the priming coat. A time interval of at least 24 hours shall be allowed between consecutive coats to permit of the proper drying of the proceeding coat. Two or more coats of distempers as are found necessary shall be applied over the priming coat to obtain an even shade.

## **16. WATERPROOF CEMENT PAINT :**

**16.1 CEMENT BASED PAINT :** Cement based paints shall be obtained from approved manufacturer and approved quality shade and colour only shall be used.

**16.2 PREPARATION OF SURFACES :** The surface shall be thoroughly cleaned of all mortar dropping, dirt, dust, algae, grease and other foreign matter by brushing and washing. The surface shall be thoroughly wetted with clean water before the water proof cement paint is applied. The surface shall be sprayed several times with a few minutes intervals between each spraying to allow the moisture to soak into the surface.

Water proof cement shall be mixed in such quantities as can be used up within an hour of its mixing or otherwise the mixture will set and thicken affecting flow and finish. Water proof cement paint shall be mixed with, in two stages.

The first stage shall comprise of 2 parts of water proof cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the water proof cement paint gradually to the water and not vice-versa. The second stage shall comprise of adding further the part of water to the mix and stirring thoroughly to obtain liquid of workable and uniform consistency. In any case manufacturer's instructions shall be followed meticulously.

**16.3 APPLICATION :** The solution shall be applied on the clean and wetted surface with hair brushes or spraying machine in a number of coats to get uniform finish. After the first coat of paint has hardened, it should be cured with water at least for 24 hours. The surface shall be wetted again before the application of the second coat, at least 24 hours should elapse between the two coats. Similarly, required number of coats (minimum two) shall be given to get a uniform colour. It should be kept damp at least for seven days or more. The solution shall be kept well stirred during the period of application. To avoid direct heat of the sun, during painting the cement based paint shall be applied on the surface which is on the shady side. Cement based paints shall not be applied on the surfaces already treated with white wash, colour wash, distemper dry or oil bound etc.

## **17. PROTECTIVE MEASURES**

Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be white washed shall be protected from being splashed upon. Splashing and droppings, if any, shall be removed by the contractor at his own cost and the surfaces cleaned. Damages if any to painted surfaces, furniture, or fittings and fixtures etc. shall be recoverable from the contractor.

## **18. MEASUREMENTS:**

**18.1** White washing, colour washing, distemping and waterproof cement paint shall be measured to the nearest 0.01 Sqm. Length and breadth shall be measured to the nearest 0.01 m. All measurements for payment shall be taken on net surface areas actually painted, unless otherwise specified.

**18.2** For jambs, soffits sills, etc. for openings not exceeding 0.50 m<sup>2</sup> each in area, and for ends of joists, beams, posts, girders, steps, etc. not exceeding 0.50 m<sup>2</sup> each in area, and for openings exceeding 0.502 m not exceeding 3 m in each area, deductions and additions shall be made in the following manner:

a) No deduction shall be made for ends of joists, beams, posts, etc. and openings not exceeding 0.502 m each and no addition shall be made for reveals, jambs, soffits etc. of these openings nor for finish around ends of joists, beams posts, etc.

b) Deduction for openings exceeding 0.50 m<sup>2</sup> but not exceeding 3.0 m<sup>2</sup> each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills etc. of these openings :

i) When both surfaces of wall are provided with the same finish, deduction shall be made for one surface only.

ii) When each face of wall is provided with a different type of finish, deduction shall be made for that side on which width of reveals is less than. that on the other side but no deduction shall be made on the other side. Where widths of reveals on both surfaces of wall are equal, deduction of 50 percent of area of opening on each surface shall be made from areas of finish.

iii) when only one surface is treated and the other surface is not, full deduction shall be made if width of reveal on the treated face/side is less than on untreated side, but if widths of reveal on both sides are equal or width of reveal on treated side is more than that on the untreated side, neither deduction for the opening nor addition for reveals, jambs, soffits, etc. shall be made.

iv) when width of door frame is equal to thickness of wall or is projecting beyond thickness of wall, full deduction for openings shall be made from each surface of wall.

v) when reveal is only one side, full deduction for the face the having no reveal shall be made and for face having reveal, deduction of 50 percent of opening shall be made.

**18.3** In case of openings of areas above 3.0 m each, deduction shall be made for opening on each surface but jambs, soffits and sills shall be measured.

**18.4** No deduction shall be made for attachments, such as casings, conduits, electric wiring and the like.

**18.5** Corrugated surface shall be measured flat as fixed and not girthed, quantities so measured shall be increased by the following percentages and the resultant shall be included in general areas:

- |      |  |            |
|------|--|------------|
| i)   | corrugated, steel sheets/G.I, sheets   | 14 percent |
| ii)  | corrugated asbestos cement sheets      | 20 percent |
| iii) | semi-corrugated asbestos cement sheets | 10 percent |

**18.6 RATE :** The rate shall include the cost of all materials and labour involved in all the operations described above.

## **SPECIFICATION FOR EPOXY PAINTING**

### **1. GENERAL:**

Unless otherwise specified, the following materials shall not be field painted copper, bronze, chromium plated nicked, stainless steel and aluminium.

Bearing surfaces, rubber surfaces, screw threads and surfaces where painting would be detrimental to the planned operation shall not be field painted.

All colours of paints shall be subject to the review and prior approval or the Engineer.

Paints shall be well ground, shall not bottle badly, cake or thicken in the container, shall be readily broken up with a paddle to a smooth consistency and shall show easy brushing properties. AH paint shall be obtained from the following paint manufacturers :

- i) The Blundell Ecomite,
- ii) The sigma,
- iii) The Goodlass Narolac,
- iv) Berger paints India LTD.,
- v) The Johnson and Nicholson.

Surface to be painted shall be indicated on the finishing schedule and as hereinafter specified, surfaces shall be thoroughly cleaned and shall be dry when the paint is applied. Paint colours not specified otherwise shall be directed by the Engineer.

Succeeding coats of the same type of paint shall vary sufficient from the colour of the preceding coat to permit ready identification. Damaged painting shall be retouched before applying the succeeding coat. Finishing surface shall be smooth, even and free from the defects. The number of paint coats specified shall be in addition to the shop priming coats. Storage of paints shall be restricted to the locations directed by the Engineer.

Except as otherwise specified all surfaces to be painted shall be clean, smooth, dry and free from grease, dust and dirt. All work shall be done in workman like manner leaving the finished surfaces free from drops, ridges, waves, laps and brush marks. Paint shall be applied under dry and dust free conditions and unless otherwise approved by the Engineer or paint manufacturers, no paint shall be applied when the ambient temperature is over 90° F. All primer and intermediate coats of paint shall be unscarred and completely integral at the time of application of each succeeding coat. Paint thoroughly stirred for sufficient length of time and kept uniform consistency during application and shall not be thinned in excess of the printed direction from the manufacturers. Paint containers shall not be opened until required for use. Floors, roofs and other adjacent work and equipment around shall be properly protected by tarpaulins or other coverings.

Painting of walls shall also include painting of backside of transparent cover plates for switch boxes, FDBS etc. including removal and refixing of the same at no extra cost.

Stainless steel liner shall not be painted with protective paint. It shall be the responsibility of the contractor to provide all the time, the able technical representative of the coating manufacturer to witness all the operations relating to coating applications in order to ensure proper surface preparation,

mixing applications, testing and inspection of the coating. The cost of this supervision and inspection shall be included in the rates quoted.

Protective coating shall be applied to all exposed carbon steel surfaces of the shielding doors, hot cell viewing window liners, crane, interior and exterior access openings, transfer drawers, cell plugs, inter cell gates duct work, piping, conduit, electrical boxes etc. inside and cells.

## **2. PROTECTIVE PAINTING WITH POLYAMINE/POLYAMIDE CURED EPOXY BASED ACID AND ALKALI RESISTANT PAINT**

The protective painting shall be carried out with epoxy based polyamine/polyamide cured special acid and alkali resistant paint of approved manufacturer.

2.1 PRIMER : Primer to be used for cement concrete wall or A.C. sheet partition shall be epoxy based primer. Primer shall be pigmented epoxy based zinc chromate primer for the metal surfaces which will not be sand blasted.

2.2 TROWELLING COMPOUND : This shall be epoxy based polyamine/polyamide cured trowelling compound suitable for appropriate surfaces such as cement concrete or plastered walls or A.C. sheet or metal surfaces as described in the schedule of quantities.

2.3 FINISHING COAT : The epoxy based paint shall be supplied in separate container for base paint and hardener delivered in sealed containers. All the epoxy based paint shall be polyamine/polyamide cured acid and alkali resistant paint. At any time, the contractor shall have sufficient quantity of paint for use on the job and such paint shall be always kept properly stirred to avoid hard setting of the same and shall be used on the work before the expiry of the shelf life period. Contractor will not be permitted to carry out any mixing or thinning at site except in the presence of representative of Engineer-in-charge. Epoxy based paint shall be prepared by mixing the adduct and the base paint in the ratio of 1:3 as per manufacturer's instructions. The paint shall be used within half hour after mixing. Consistency of the mixed paint shall not be less than 40 seconds in Ford's cup test.

## **3 CHEMICAL AND PHYSICAL PROPERTIES OF PROTECTIVE PAINT COATINGS :**

Protective coating of epoxy based polyamide/polyamine cured acid and alkali resistant paint to be on this work shall generally satisfy following chemical and physical properties.

The contractor shall produce necessary test certificates to the effect that the paint he proposes to use on this work satisfies all the physical and chemical tests mentioned below :-

In case the protective coating proposed by the contractor does not satisfy any of the tests prescribed, the same shall be clearly mentioned at the item of tendering. If found necessary by the department, the contractor shall submit test specimen required for all the tests to the Engineer.

Testing shall be done by contractor at his own cost. Test shall be witnessed by the departmental Engineer. The test specimen shall also be prepared free of cost during scrutiny offender, if called for.

## **4. PREPARATION OF TEST SPECIMENS :**

4.1 Mild steel panels 3" x 6" x 1/4" shall be sand blast to white metal with profile of 3 miles. The panels shall be primed within 8 hrs. after sand blasting. If this period is exceeded, it shall be reblasted until the metal becomes white.

4.2 Concrete block 3" x 1 1/2" shall be prepared using a minimum 6 bags of cement, 4" slumps. Portland cement, river sand and 1/4" top soil aggregate 3000 psi strength at 28 days. The block shall be allowed to cure for 30 days minimum then shall be given a light sand blast to roughen the surface.

**4.3** The block shall be entirely dry prior to coating applications.

The steel and concrete panels required for these tests shall be coated strictly in accordance with specifications as detailed earlier.

## **5. PROPERTIES OF PAINT :**

**5.1 DEMINERALISED WATER RESISTANCE :** One concrete and one steel panel shall be washed ; well with warm (120° F) water before testing.

The coated specimen shall be immersed in demineralised water whose resistance is not less than 0.02 meg. Ohms/cm, maintained at 130° F. The water will be changed every 48 hours. Continue the test for 20 days. The specimen shall be examined immediately after the removal from the water and again after 24 hours drying at room temperature.

There shall be no flaking, cracking or softening of film and the integrity of the film shall remain intact.

**5.2 CHEMICAL RESISTANCE :** Only steel panels to be used of this. One of the coated specimen shall be immersed in each of the following chemicals.

- (i) 50% sodium hydroxide at 150° F for 20 days.
- (ii) 50% sulphuric acid at 90° F for 20 days.
- (iii) Kylol at 80° F for 20 days.

There shall be no flaking, cracking or softening or film and the integrity of the film shall remain intact.

The tenderers may please note that it is obligatory on their part, if required by the department to paint the reasonable area, say about 10 sqm of concrete/plastered surfaces and about 2 sqm. of steel surface as , samples to judge the quality of paint used, the workmanship and performance of the painted area. The quality of material and workmanship of sample shall also be the one of the criteria of award of work. The area of sample painting shall be indicated by the Engineer. The sample painting shall be measured and paid for at the rates quoted by the respective tenderers.

## **6. SURFACE PREPARATION :**

### **6.1. SURFACE PAINTED WITH PROTECTIVE PAINT OF EPOXY BASED PAINT :**

**6.1.1** New wall surface shall be allowed to dry for a minimum period of 45 days or for such time as if necessary to make the surfaces dry enough for painting before any normal painting work is carried out.

**6.1.2** Any water or air pits of pin holes in the surfaces shall be thoroughly chipped out and filled with epoxy based trowelling compound.

**6.1.3** Asbestos sheet surface shall be scrubbed with solution of mild detergent in warm water to remove all loose matters and soils and then flushed with clean water and surface shall be allowed to dry thoroughly.

### **6.2 CEMENT CONCRETE FLOORS WITH STEEL TROWEL FINISH :**

The concrete surfaces shall be first generally prepared on the similar lines as stated in (i) above. However, the floors and smooth plastered surfaces shall be etched with acid to provide sufficient key for the paint film. The procedure for etching of cement concrete surface to remove glaze and concrete maintenance, shall be as follows:



**6.2.1** Etch with solution of one part of commercial hydrochloric acid and two part of clean water. The solution shall be applied with brush or spray until the solution runs.

**6.2.2** The solution shall bubble for 1/4 or 1/2 minutes and then stop. When bubbling stops, the etching shall be deemed to have been complete.

**6.2.3** When etching is complete, the surfaces shall be washed down with clean running water at the same time brushing with stiff brush to remove residual acid and salt, completely. The surface will appear slightly granular and free from any glaze.

**6.2.4** Repeat acid process if necessary to obtain the uniformly roughened surfaces.

**6.2.5** Then neutralised by washing with 5% solution of soda ash or trisodium phosphate and rinse with clean water. Surfaces to be coated shall be allowed to dry completely prior to application of primer or lacquer coat.

**6.3 METAL SURFACES OF HOLLOW METAL DOORS, ROLLING SHUTTERS, SLIDING DOORS, M.S. FRAMES, SHIELDING DOORS ETC.**

Surfaces shall be cleaned thoroughly living it free from all mill scales, rust, grease, old coating, if any, moisture and other impurities with the help of wire brushes with manual or mechanical operations, emeric paper, rust removing compound such as D' rust or equivalent compound. Steel surfaces which are already having a primer coating of non epoxy based paint shall be removed thoroughly and the rate for painting shall include the cost of thorough removal of this primer coat before painting with epoxy based paint.

**6.4 WORKMANSHIP:**

**General:**

Any cracks in the plastered surfaces shall be filled with plaster of Paris and the surfaces rubbed smooth before taking up sandpapering etc. All surfaces to be painted shall be perfectly dried and cleaned and free from any dirt or dust. The surface shall be rubbed smooth by means of sandpaper, emeric paper or pumic stone to the satisfaction of the Engineer before starting the painting work. The surface shall be thoroughly dried free from oil, grease, acid or alkali or loose materials, cleaning to the surfaces. If necessary, this shall be tested for the presence of excessive alkalies and moisture. The moisture could be determined either by copper sulphate, test or rubber mats tests and free alkali and moisture. The moisture could be determined either by copper sulphate, test or rubber mats tests and free alkali could be determined by universal indicator which should not indicate more than 7.5 PH. The test shall be made by the contractor at no extra charge and the compliance of otherwise of these tests shall not relieve the contractor for his responsibility for making good the paint at his own cost in case the paint peels off due to bad preparation of surface or due to presence of moisture of alkali or due to any reason whatsoever.

**6.5 PROTECTIVE PAINTING WITH EPOXY BASED CEMENT**

Painting of cement concrete walls, cement plastered surfaces, A.C. sheet partitions etc.

After the surface partition as stated earlier, one coat of epoxy based primer shall be applied over the entire surfaces. After 24 hours, if dry patches are noticed, the same shall be touched up with clean lacquer.

After 24 hrs. interval, apply one finishing coat of polyamine/ polyamide cured epoxy based acid and alkali resistant paint.

After interval of 24 hours, fill up all the air holes, indentations and uneven in the surface by applying one coat of epoxy based trowelling compound.

Apply two remaining finishing coats of epoxy based polyamine/polyamide cured acid and alkali resistant paint, of approved make and tint at interval of 24 hours. No subsequent coat of paint shall be applied unless the previous coats have sufficiently got hardened. The paint shall be cured for a minimum 7 days and tested satisfactorily for MIBK test and acetone test.

## **6.6 PROTECTIVE PAINTING OF CEMENT CONCRETE FLOORS AND OTHER SMOOTH FINISHED CONCRETE SURFACES.**

**6.6.1** After preparation of the surface as stated earlier, and after etching of surfaces with hydrochloric acid as specified hereinbefore, apply one coat of epoxy based primer.

**6.6.2** After 24 hrs. interval, apply one finishing coat of polyamine/polyamide cured epoxy based acid and alkali resistant paint.

**6.6.3** After 24 hrs. fill up all the air holes, indentations of the surface by applying one coat of epoxy based trowelling compound.

**6.6.4** Apply the remaining two finishing coats of epoxy based polyamine/polyamide cured acid and alkali resistant paint of approved tint at intervals of 24 hrs. No subsequent coat of paint shall be applied unless the previous coats satisfactorily got hardened. The paint shall be cured for a minimum period of 14 days and shall be tested for MIBK test and Acetone tests.

## **6.7 PROTECTIVE PAINTING OF HOLLOW METAL DOORS, ROLLING SHUTTERS, SLIDING DOORS, INTERCELS GATES, CELL DOORS, ETC.**

**6.7.1** After the surface preparation as stated hereinbefore, apply one coat of pigmented epoxy based zinc chromate primer.

**6.7.2** After 24 hrs. interval, apply one coat of epoxy based polyamine/polyamide cured special acid & alkali resistant paint of approved tint.

**6.7.3** Apply one coat of epoxy based trowelling compound wherever necessary to fill in gaps or unevenness of surfaces.

**6.7.4** After 24 hrs. interval, repeat the remaining three finishing coats of epoxy based polyamine/polyamide cured acid and alkali resistant paint of approved tint.

**6.7.5** Curing and testing of the surfaces shall be same as in (ii) above.

## **6.8 FIELD TESTING OF PAINTING SURFACES:**

**6.8.1** All the protective paint coatings with epoxy based acid and alkali resistant paint shall provide a minimum film thickness of 5 mils. All steel surfaces shall be tested for the film thickness with the help of electrometer.

The apparatus required for testing the film thickness shall be made available by the contractor as and when required without any extra cost to the department. IN case 5 mils thickness is not achieved, contractors shall have to apply an extra coat at their cost to achieve the same.

**6.8.2** After curing the epoxy based paint for the minimum period of 7 days during which period. The paint surfaces shall be well ventilated and protected from direct exposure to the sun light or flames etc. The painted surfaces shall be subjected to following two tests which shall be carried out by the contractors at his/their own cost.

**a. MIBK TEST :** A swab of cotton wool soaped with Methyl Isobutyl Ketone is to be sealed against the painted surfaces covered with a watch glass. After one hour, there should not be any softening of the film.

**b. ACETONE TEST :** rub on the painted surface with a swab of cotton wool soaped in acetone for one minute continuously. There should not be any softening of the film.

**6.9 MODE OF MEASUREMENT :**

The painting except where otherwise stated shall be measured in Sqm, the net surface areas shall be actually painted. No deductions will be made for opening for grills, ventilation, outlets, vision panels, electrical boxes etc. if they are individually not exceeding 0.5 sqm. Similarly, no addition shall be made for painting the beading, moulding, edges, jambs, soffits, sills, etc. of such openings.

Painting on different types of works shall be measured as one item, areas of uneven surfaces being converted into equivalent plain areas as indicated below :

Sl. No.	Description	How to Measure	Multiplying Factor
1.	Flush door with or without louvers	Measured flat (not girthed) including frame between plastered edges	1.2 for each side
2.	Fully glazed door	Measured flat (not girthed) including frame between plastered edges	0.8 for each side
3.	Partly panelled / flush and partly glazed door	Measured flat (not girthed) including frame between plastered edges	1.00 for each side
4.	Pipe railing	Measured individually, the exposed pipe and area calculated	-
5.	Walls	Same as plaster	One

Wherever air-conditioning grills, lighting fixtures, etc. in false ceiling are painted, measurements shall be taken overall without deductions for opening in grills and no extra shall be paid for the grills. If grills, fixtures, etc. are not painted, area of fixtures or grill as measured flat (not girthed) shall be deducted when it exceeds 0.5 sqm individually.

Beading wherever provided shall not be measured separately but shall deem to be included in the overall area, measured flat (not girthed). All the painted surface of special equipment, items of cells as also liners etc. shall be measured net.

All painted surface might be left with matt finish or egg shell finish, light stippling or good stippling yielding an orange peel texture or might be left alternatively a required by the Engineer. The contractor shall offer any of the finishing required at no extra cost and arrange quality paint accordingly.

## Specification for acid and alkali resistant flooring/skirting/dado.

Acid and alkali resistance tiles shall be red stone (Mandana) of best quality of 30 to 50mm thick for flooring and 20 to 30 mm thick for skirting/dado or thickness as specified in schedule and of size 600 mm x 450 mm/600mm x 600 mm or as directed by Engineer. The stones shall be obtained from approved sources. The stone shall have to be machine cut/hand cut as specified and double machine polished. The edges to be pointed shall be true to line and dressed to the depth all round. The stones shall be hard sound, free from cracks, veins and other defects and of uniform colour. The samples of stones shall be submitted for approval of the Engineer. All the stones incorporated in the work shall confirm to the approved samples.

The mortar should be chemically setting silicate type mortar and resistant to organic acid, nitric acid, chronic sulphuric, hydrochloric acid, salt solutions, aliphatic and aromatic hydrocarbons, ketones, fats and oils etc. The mortar should be testifies the following test according to IS specifications :

		Type of Mortar		
		Aciderm NA		Aciderm KB
1.	Setting time (Minute)	180		175
2.	Hardening Time	24	To	36 hours
3.	Working time (minute) 50	50		
4.	Compressive strength kg/cm <ul style="list-style-type: none"> <li>• 7 days</li> <li>• 2 days</li> </ul>	200 240		280 320
5.	Transverse strength kg/cm <ul style="list-style-type: none"> <li>• 7 days</li> <li>• 2 days</li> </ul>	65 68		105 130
6.	Bond strength kg/cm <ul style="list-style-type: none"> <li>• 14 days</li> </ul>	5	To	6
7.	Porosity (percent)	14	To	15
8.	Max. service temperature (x <sup>c</sup> )	1000		1000
9.	Bulk density of mortar kg/m <sup>3</sup>	1930	To	2010

Before laying the flooring/skirting/dado, surface to be paved shall be thoroughly hacked, cleaned or all mortar scales, concrete lumps, loose materials etc. Surface should be washed to remove mud, dirt etc. Surface should be rough and dry, if necessary slightly heat the surface with help of a blow lamp to evaporate the moisture. Prepared surface must be ensured free from dirt and dampness. Unless and until the surface is approved by the Engineer, the flooring shall not be started.

Applying 2 to 3 mm thick hot bitumen of grade 30/40 with a brush and sprinkle coarse angular grains of dry over surface. Allow the surface to dry for 24 hours till the bitumen hardens.

First take 300 ml. of acid resistance liquid in an enamelled or G.I. tray and mix 1.0 kg. of dry solid acid resistance powder with the liquid by slowly sprinkling and sufficient trowelling to make the mortar pasted of tolerable consistency. The quantity of mortar that could be conveniently used before

it start setting, should be mixed as the setting time of mortar also depends on the temperature or as per manufacturer's specifications.

A bedding of acid proof mortar 8 to 10 mm thick shall be laid evenly to levels or slope as directed. Red sand stone shall then be laid on the bedding with or backing of the acid proof mortar. All stone tiles shall be truly and evenly set and pressed in position to obtain uniform plain surface. The tiles shall be close jointed and all joints shall be uniform and run in perfect straight lines. The joints shall be staggered or continuous as directed by the Engineer.

Flooring/skirting/dado should be cured by use of brush with 20 to 25 percent solution of commercial hydrochloric acid in water to the joints, which should be repeated at a duration of every 3 to 4 hours fro a total period of 6 days.

The curing must be started after 24 hrs. after laying of flooring/skirting/dado or as per manufacturer's specifications.

The measurement shall be the actual area covered from the face of skirting. Deduction will be made for the areas not covered. The unit of measurement shall be Sq.m.

# **PART -E**

## **SPECIFICATIONS FOR INTERNAL PUBLIC HEALTH WORKS**

### **1. GENERAL**

**1.1** All sanitary fixtures shall be got approved by the Engineer prior to installation of fixtures and approved samples shall be maintained at site till the completion of the work. The type and quality of fixtures, fittings and other accessories shall generally be as those provided in completed portion of the project unless otherwise specified and directed.

**1.2** All rates for fixing shall provide for making holes in walls, providing screw, wooden plugs and clips where necessary cutting floors, chasing involves and floors and making good and restoring them to original conditions. The rates are for the completed works as laid down in the schedule and the contractor is not entitled for any payment except in case of any brick masonry or concrete structures, which are of special nature in the opinion of the Engineer for which payment shall be made in accordance with the relevant rates in schedule of approved rates.

**1.3** The contractor carrying out the construction work shall take effective steps to carefully open, cut all existing channels, culverts, bridges, pipelines, water sources, conduits, sewer drains, electric cables, transmission lines and their supports and all other works buried or otherwise, where such have to be interfered with for purpose of the construction of the works. He shall provide and arrange all necessary temporary supports and diversions, if necessary for across, under, over through and alongside of the trenches and all other parts of construction work and shall leave all such existing channels, culverts, bridges, pipe lines, conduits, water sources, sewers, electric cables transmission lines, telegraph and telephone lines and all other works in their original condition to the satisfaction of the Engineer.

**1.4** The sanitary fittings and fixtures shall be handed over to the Engineer complete in all respects on the completion of work and no incomplete items will be taken over. Any loss or damage to these due to any reasons whatsoever before the handing over, will be the contractor's cost and charges.

**1.5** All exposed or concealed pipes and special, C.I., G.I. and lead shall be painted with three coats of approved paint of approved colour. The rate for all piping shall be inclusive of cost for such painting.

### **1.6 CEMENT CONCRETE (1:2:4):**

The rate includes for providing and laying all necessary materials and providing labour tools and plants required for the same. The concrete shall consist of 40.86 kg. of cement to 0.0566 cum. of clean washed sand and 0.1132 cum. of well graded stone aggregate of maximum 20 mm gauge i.e. in the ratio of 1:2:4. It includes cost of mixing, formwork, laying to proper slopes and sections, curing.

### **1.8 BRICKWORK:**

The rate includes for providing and laying all necessary materials and providing labour tools and plants required for the same. It shall be with class 50 bricks conforming to IS : 1077 in a mortar consisting of 40.86 kg. of cement and 0.1415 Cum. of clean washed sand or in proportion specified in the schedule of quantities. It includes the cost of scaffolding and curing.

### **1.9 20MM/15MM THICK CEMENT PLASTER :**

The rate includes for providing and laying all necessary materials and providing labour, tools, and plants required for the same. The plaster shall be of 20mm/15mm thick and shall consist of 40.86 kg. cement to 0.849 Cum. of clean washed sand or in the proportions specified in the schedule of

quantities. A 0.8 mm thick floating coat of neat cement shall be given on the plaster for internal surface. It includes the cost of racking out the joints of brick masonry and curing.

## **2. SANITARY FITTINGS AND ACCESSORIES :**

### **2.1 ORISSA WATER CLOSETS :**

The rate includes providing and fixing the following components as described in the schedule.

- (a) Best Indian make Orissa type, Indian water closet pan of size specified with 'p' or 's' trap with or without bend in white glazed earthenware and conforming to M/s. Hindustan Sanitaryware booklet pen No. 20.004 or M/s Johnson & Johnson or M/s. CERA or equivalent.
- (b) P.V.C. low level flushing cistern conforming to M/s. Parryware or equivalent alongwith C.P. brass flush bend. 10 litres capacity with all internal fittings with necessary overflow arrangement, mounted on a pair of M.S. galvenised brackets fixed to the walls with wooden screws and wooden dwells with rubber and metal washers and also to be fixed to wall with 2 nos. screws on the rear side of the PVC flushing tank conforming to IS: 723-1974 complete as per drawing, specifications and as directed by the Engineer-in-Charge.
- (c) 15 mm n.b. Heavy lead inlet connection with brass unions and wiped solder joints at end.
- (d) 15 mm n.b. C.P. heavy type stop cock easy clean type.

OR

- (a) Best Indian make Orissa type, Indian water closet pan of size specified with 'p' or 's' trap with or without bend in white glazed earthenware and conforming to M/s. Hindustan Sanitaryware booklet pen No. 20.004 or M/s Johnson & Johnson or M/s. CERA or equivalent.
- (b) Mosquito proof high level Cast Iron flushing cistern 'Nomos' or equivalent make 10 litres capacity with 15mm copper valve chain and pull and other fittings, supported on C.I. brackets, both cistern and brackets, painted with 3 coats of approved paint.
- (c) 32mm n.b. heavy stainless steel flush pipes of appropriate length with necessary brass unions and wiped solder joints, bend to proper shape and fixed in position.
- (d) 15mm n.b. G.I. overflow pipe medium quality with necessary specials from the cistern upto about 15 cm. above floor level with mosquito proof perforated C.P. brass cap.
- (e) 15mm n.b. C.P. approved heavy type stop cock easy clean type.
- (f) 15mm n.b. Heavy head inlet connection with brass unions and wiped solder joints at end.

The rate shall include for cutting, chase in walls, floors and other structural members fixing the closet pan in brick bat concrete or cement concrete 1:2:4 as instructed and restoration of surface to original conditions complete.

### **2.2 WASH BASIN**

The rate includes for providing and fixing the following components as described in the contract schedule

- (a) Best Indian make white glazed vitreous Chinaware wash basin of size specified with one tap hole at Centre, and anti-splash rim. The wash basin conform to M/s. Hindustan Sanitaryware booklet plate No. 19.095 or M/s Johnson & Johnson or M/s. CERA OR equivalent.
- (b) Concealed C.I. bracket of approved quality for supporting wash-basin.

- (c) Suitable chromium plated brass waste coupling heavy quality with rubber plug C.P. brass chain and stay.
- (d) Suitable heavy type C.P. brass bottle trap with extension piece and wall flange.
- (e) One no. of 15 mm C.P. brass heavy quality pillar tap 'ESSCO' or equivalent make with triangular knob at top.
- (f) One number C.P. brass heavy quality screw down easy clean variety stop cock on inlet connection.
- (g.) One number 15 mm n.b. heavy quality PVC inlet connection with a brass union and wiped solder joints at end.

**Note :** C.I. brackets and exposed pipes to be painted with three coats of approved paint.

### **2.3 MIRROR:**

The mirror shall be of size specified with bevelled or plain edges as specified in Schedule made from plate glass manufactured by M/s. Hindstan Pilkington or equivalent mounted on PVC sheet backing with decorative PVC frame fixed to walls with C.P. brass screws with washer, rawl plug, etc. The rate includes for making necessary holes in wall and fixing rawl plugs etc. complete.

### **2.4 LIQUID SOAP DISPENSER**

The soap solution container shall be of 'Homocole' make or equivalent. It shall be of C.P. brass approved type with C.P. brass cap and C.P. brass brackets. The rate includes for fixing to wall with C.P. brass screws, rawl plugs etc., complete.

### **2.5 COAT AND HAT HOOK**

The coat and hat hook shall be of heavy quality double pronged type in oxidised or chromium plated brass fixed with oxidised or chromium plated brass screws. The rate includes for making necessary holes in walls and fixing rawl plugs etc. complete.

### **2.6 TOWEL ROD OR RAIL**

They shall be of best quality C.P. brass tube with a pair of C.P. brackets of approved make 'BILMAT' or equivalent and of size as specified in schedule. The rate shall also include fixing of the towel rail to wall with necessary chromium plated brass screws including provision of wooden rawl plugs, for fixing there of. The fixing arrangement shall be of concealed type.

### **2.7 C.P. BRASS SHOWER**

The C.P. Brass showers shall be swivel type with ball socket joined of M/s. ESSCO or equivalent make and shall be of size specified in schedule. It shall be provided with 15 mm C.P. Brass throw of arm of appropriate length with C.P. wall flange. The rate includes for providing and fixing the above.

### **2.8 FLUSHING CISTERN FOR URINALS**

The automatic cistern shall be porcelain enamelled seamless/pressed steel of M/s. Fordham or equivalent and of capacity as specified in Schedule, supported on a pair of enamel painted M.S. brackets fixed to the wall as directed and the rate shall include the following fittings in addition to the cistern:-

- (a) C.P. brass common distributor pipe for the urinals fixed to wall with C.P. brass clamps.
- (b) 15 mm n.b. C.P. spreader of approved type one for each urinal.



(c) 15 mm n.b. heavy quality PVC inlet connection for flushing tank with brass unions and wiped solder joints at ends.

(d) 15 mm G.I. overflow pipe with specials concealed in wall from the cistern upto 150 mm above floor level terminated with 15 mm C.P. brass perforated cap complete.

(e) 15 mm n.b. heavy type approved make C.P. brass stop cock easy clean variety on the inlet connection to the tank.

## **2.9 MARBLE PARTITION**

The marble partition shall be of thickness as specified in the item and shall be best Indian white marble machine cut and polished on all sides with rounded comers and of sizes as specified built 75 mm, into the wall. The rates shall include cutting grooves in the wall where required and fixing etc. complete.

## **2.10 WHITE GLAZED HALF ROUND CHANNEL**

The half round channel used shall be of best Indian make white glazed vitreous chinaware and of the specified size. They shall be bedded on shall be fixed over a bed of cement concrete of ratio 1:2:4 laid to proper slope and shall be fixed over a bed of cement sand mortar 1:3, 19 mm thick. The joint shall be pointed with white cement. The cost shall include, provision for dead ends, wastage etc.

## **2.11 FLOOR TRAP**

The floor trap shall be of cast iron with outlet of the required size. The rate shall include fixing the trap in cement concrete 1:2:4 and for providing a chromium plated brass heavy type grating on top of trap.

In case the trap is fixed at a lower level than the floor, the inlet to the trap will be formed with 1:2:4 cement concrete in cylindrical shape with the inside dia, equivalent to the top diameter of the trap and the grating will be fixed at floor level. The minimum water seal shall be 50 mm or as specified in the item

## **2.12 BIB TAPS, STOP COCKS-CONCEALED STOP COCKS**

They shall be of 'ESSCO', M/s BILMAT, GEM, METRO or equivalent make and shall be of Chromium plated brass or oxidised brass as stipulated. They shall be of heavy quality, easy clean type provided with capstan head or of any fancy type head. The size shall be as specified in the schedule.

The concealed type stop cock shall be provided with a C.P. brass cast flange.

## **2.13 GULLEY TRAPS AND CHAMBERS**

The gulley traps shall be of best quality stoneware salt glazed with 15 cm sq. intel and 100 mm clear outlet, thoroughly burnt throughout the whole thickness of a close and even texture, free from air blows, fire blasts, cracks and other imperfections. The trap is to be embedded in cement concrete 1:2:4. Construction of gulley chamber and provision of hinged C.I. cover as described in the schedule and described elsewhere in this specification is included in this item and no separate rate is payable on this account.

## **2.14 G.I. PIPE WORK**

The galvanised iron pipes and specials shall be of class indicated in the item and confirm to I.S.S. no. 1239/1968 (part I and II). The pipe shall be of 'TATA' make or equivalent. The rate includes for cutting to required lengths, threading, jointing, fixing, testing and removal of leakages. When fixed "11 v^alls exposed, the pipes shall be fixed on wooden packing, with clamps and screws such that they are at Ica.-^i 4U mm, away from the wall wherever required. All pipes and specials shall be got approved

by the Engineer before incorporation in work. The rate includes for cutting through walls and floors and making good the same thoroughly wherever pipes are concealed to the entire satisfaction of the Engineer. The pipe shall be painted with 3 coats of approved paint to the exposed surfaces and 2 coats of bituminous paint to concealed surface and shall be tested to 100 meter head of water (10 kg. per sq. cm ) and the pressure maintained for two hours. Leakages, if any, shall be make good by the contractor and the pipes and special rendered absolutely water tight. Measurements for the finished work shall be taken along the longitudinal axis of the pipe line. The rate shall include the cost of all specials fitting etc. complete.

All G.I. pipes which are to be concealed in wall and floors shall be tested to the required pressure and leakages and defects rectified prior to restoring the walls on top. The rate includes for testing the valves to 100 mtr. head of water, replacing the defective valves etc. complete.

#### **2.15 GATE VALVE :**

The gate valves shall be of gun metal, screw down type heavy quality and approved make (M/s. Leader or equivalent make) provided with hand wheel on top. The rate includes for testing the valves to 100 mtr. head of water, replacing the defective valves etc. complete.

#### **2.16 C.I. SOIL VARIETY SOIL, WASTE, VENT, ANTISYPHONAGE AND RAIN WATER PIPES:**

The soil, waste, vent, antisiphonage and rain water pipes and specials shall be of approved heavy quality and make sand cast centrifugally cast conforming to IS : 1729 or 3989 respectively. If Sand cast conforming to IS : 1729, the pipe shall be of 'ELC', 'HCL' or equivalent make and if centrifugally cast conforming to IS : 3989 they shall be 'INDO SURDISH' pipe manufacturer's make or equivalent. The rate includes for providing specials with access door wherever necessary, jointing with spun yam and pig lead including testing and removal of leakages. The rate includes for making chases and holes in walls, floors, etc. and making good the surfaces and restoring them to original conditions. All measurements shall be taken along the longitudinal axis of the pipe line. The pipe in exposed position shall be fixed to walls of building by M.S. heavy flat iron claps and wooden packing, so that the pipes are 50 mm away from the wall face. All C.I. pipes and specials shall be painted with coats of approved oil paints of approved shade.

All soil pipes which are to be concealed in walls and floors shall be tested to the required pressure and defects rectified prior to restoring the walls and floors to original conditions.

#### **2.17 PVC BALL VALVE**

The ball valve shall conform to IS. The connecting rod shall be of brass and the same shall not bend or give away after installation. The ball valve shall withstand high pressure upto 3.5 kg./sq.cm.

#### **2.18 WHITE GLAZED VITREOUS CHINAWARE TRAP**

The trap shall be of white vitreous chinaware and shall be of M/s. Hindustan Sanitaryware' or equivalent make and size specified with approved chromium plated hinged dome grating at top. The traps shall be fixed and embedded in cement concrete 1:2:4, 75 mm thick.

#### **2.19 LEAD/G.I. SHEET FLASHING AND C.I. GRATING**

Lead/G.I, sheet flashing formed out of 3 mm thick lead/G.I, sheets as specified in the item shall be provided around rain water pipes. The lead/G.I, sheet shall project 200 mm around beyond the outer face of the socket of the rain water. The rate includes bending and breaking the sheet to shape, placing in position, tucking below water proofing course etc.

The flashing shall project inside the pipe for at least 80 mm in case of 150 mm pipe and 50 mm in case of 100 mm pipe.

G.I. Grating of the size of the pipe shall be provided at the mouth of the rain water pipe.

## **2.20 EUROPEAN WATER CLOSET**

The rate includes for providing and fixing European water Closet suit comprising.

- (a) Double Syphonic Pattern coupled European water Closet in white vitreous chinaware with integral 'P' or 'S' trap conforming to M/s. HINDUSTAN SANITARYWARE Booklet plate No. 20:007 or M/s. Johnson & Johnson or M/s. CERA or equivalent.
- (b) Solid plastic seat of approved make and shade with C.P. pillar hinges and rubber buffers.
- (c) 15 mm n.b. heavy quality C.P. brass overflow pipe 150 mm long with C.P. brass jali at end.
- (d) 15 mm n.b. heavy quality PVC inlet connection with brass union and wiped solder joint.
- (e) 15 mm n.b. screw down easy clean variety heavy quality C.P. brass stop cock.
- (f) PVC low level flushing cistern of make M/s Parryware or equivalent, 10 liters capacity with all internal fittings with necessary overflow arrangement, mounted on a pair of M.S. galvanised brackets fixed to the walls with wooden screw and wooden dwels with rubber and metal washers and also to be fixed to walls with 2 nos. screws on the rear side of the PVC flushing tank conforming to IS : 7231-1974 complete as per drawing, specification and as directed by the Engineer-in-Charge.

## **2.21 TOILET PAPER ROLL HOLDER**

The rate includes for providing and fixing recessed type 150 mm x 150 mm toilet paper roll holder in white glazed vitreous chinaware including cutting into wall making good the same, etc. complete. It shall conform to M/s. Hindustan Sanitaryware Booklet No. 40.004 or equivalent. The toilet paper roll holder shall be provided with wooden rod and necessary spring to hold it in position. The rate does not include paper roll

## **2.22 GULLEY CHAMBER**

The rate for this item includes the following

- (i) 1:4:8 cement concrete of specified thickness in bedding with 150 mm. offset over the masonry.
- (ii) Brick masonry in cement mortar of specified ratio to give the inside clear dimension given in the schedule before plastering the chamber.
- (iii) 20mm cement plaster 1:4 inside and outside finished with a floating coat of neat cement inside.
- (iv) C.I. frame and cover of weight specified and fixed in cement concrete 1 :2:4. The cover and frame shall be painted with three coats of anticorrosive black paint.

## **2.23 LEAD PIPE / PVC PIPE**

It shall be of best Indian made solid down, of size specified and conforming to I.S.S. No. 404. The cost includes providing brass specials such as unions, thimble wherever necessary all soldered to lead pipes with soldered joints. The rate includes for bending to shape, fixing to walls with G.I. clamps over wooden cleats painting the pipe with 3 coats of approved paints etc. Alternatively if specified, PVC pipe shall be provided as per manufacturer's specification.

## **2.24 C.P. BRASS BOTTLE TRAP**

The bottle trap shall be 'M/s.ESSCO' or equivalent make. It shall be of heavy quality brass chromium plated. The trap shall be supplied with extension piece and wall flang.

## **2.25 LABORATORY AND KITCHEN SINK**

They shall conform to M/s. PARRYWARE for lab. Sink and M/s. HINDUSTAN SANITARYWARE booklet plate No. 50.002 for kitchen sink equivalent make in white glazed vitreous chinaware or fine clay as described in schedule. The sink shall be supported on a pair of C.I. or M.S. brackets, painted with white enamel paint. They shall be provided with one number suitable heavy quality C.P. brass waste with rubber plug, C.P. Chain etc. complete. Kitchen Sink shall be provided with fluted drain board as per M/s. Hindustan Sanitaryware's cat No. 50.001 or equivalently of stainless steel sink is specified then it shall be of 20 gauge and shall be of Nirali or equivalent make.

## **2.26 SWAN NECK TAPS :**

The rate includes providing and fixing heavy quality 15 mm n.b. C.P. brass or oxidised brass swan neck taps with three single or serrated outlets as provided in schedule. They shall be M/s. ESSCO or equivalent make

## **2.27 LOW LEVEL FLUSHING CISTERN**

It shall conform to M/s. Parryware or equivalent and shall be PVC along with flush bend 150 mm long C.P. brass overflow pipe, it shall be of 10 litres capacity.

## **2.28 SOAP TRAY**

It shall be in vitreous chinaware recessed type M/s. Hindustan Sanitaryware's trap no. 140009 or equivalent. The includes or cutting of wall for making chases and finishing the wall back to original surface.

## **2.29 ELECTRIC WATER HEATER**

It shall be of capacity mentioned in schedule M/s. Spherhot or equivalent make pressure type including accessories. The rate includes cutting of wall for fixing rawl plugs, C.P. screws for fixing testing after installation etc. The installation shall be done instructions of engineer. The rate does not include provision of electrical connection to the heater.

## **2.30 FLAT BACK URINAL**

It shall be large flat back urinal in white glazed vitreous chinaware of size specified, m/s. Hindustan sanitaryware's cat plate 60.002 or equivalent make. The rate includes fixing to wall with necessary wooden plugs, C.P. brass screws etc. The urinal shall be provided with 32mm C.P. brass heavy quality waste and 32 mm. c.p. brass heavy quality bottle trap with extension piece and wall flange.

## **2.31 URINAL DIVISION PLATE**

It shall be in white vitreous chinaware of size mentioned in schedule and m/s. Hindustan sanitaryware's cat plate no.61.001 or equivalent make. The rate includes fixing with necessary accessories such as rawl plugs/ wooden plugs and c.p. brass screws.

## **2.32 G.I. GRATING**

The grating shall be 25mm thick and shall be of best casting, M/s. Ashok iron or equivalent manufacture. It shall fit properly after placing on to the frame and shall be painted with three coats of approved enamel paint over primer. The size shall be as mentioned in schedule.

## **2.33 C.P. GRATING**

It shall be heavy type. The rate includes necessary cutting of floor finishing etc.

### **2.34 M.S. FRAME AND COVER**

It shall be as per the drawing issued and relevant civil specifications for fabrication shall apply. The rate includes fixing the frame in cement concrete 1:2:4

### **2.35 INSPECTION CHAMBER WITH C.L FRAME, COVER AND STEPS**

The relevant civil specification for brick masonry shall apply for brick masonry of Chambers. Other things as described in schedule shall be provided. C.I. frame and covers shall be of best casting M/s. Ashok Iron's manufacture or equivalent, and of weight specified. The rate includes fixing of C.I. frame and cover in cement concrete 1:2:4. Frame and cover shall be painted with two coats of anticorrosive bitumastic paint.

## **3. MATERIALS**

All materials used in the work shall conform to the relevant IS! specifications and all works shall be carried out as per standard code of practice.

## **4. COST TO BE COVERED**

The full cost of all work and labour required to be done and of all materials, plant, tools and tackle transport, taxes, rent and all other incidental charges and expenditure for the provision, fixing, erection, construction and completion of the various clauses of works described in this specification and in the performance of all other work and duties specified and described herein except as may be otherwise expressly and explicitly provided, shall be covered by the various items of completed work laid down in the schedule and no payment in respect thereof other than the rates for completed work laid-down in the schedule, shall be allowed to the contractor.

## **5. HIGH DENSITY POLYETHYLENE (HDPE) PIPES AND SPECIAL FITTINGS**

The pipes shall be extruded and special fittings shall be fabricated from the compound consisting of virgin polyethylene in which carbon black and a suitable non-toxic anti-oxidant are evenly dispersed. The addition of not more than 10% of the manufacturer's own rework resulting from the manufacture of pipes is permissible. No other rework material shall be used.

The properties and performance requirements of the HDPE pipes and special fittings shall conform to IS : 4984-1972. The wall thickness of the HDPE pipes shall be for a working pressure of 6 kg./sq.cm. at 27 degree centigrade as per Table I of Is : 4984-1972. All pipes and joints between pipes and special fittings shall be of the best workmanlike manner and 100% leak proof and shall satisfy all the test specified in I.S. : 4984-1972. HDPE pipes and special fittings shall be of correspondence time interval and wall thickness as per Table I of I.S. : 4984-1972 for a working pressure of 6 kg/sq.cm. at 27 degree centigrade. These pipes and fittings shall be approved make obtained from polyethylene Ltd. Bombay.

### **5.1 LAYING OF HDPE PIPES**

HDPE pipes will be laid in a workmanlike manner to proper slope/grade/level as indicated in drawing and/or as directed by the Engineer. The pipe joints shall be formed preferably by butt welding using electric hot plate for heating the ends of pipes. Where the joints are detachable like connecting to tanks, pumps, valves or other existing flanges, flange joints shall be provided with 3 mm thick neoprene gaskets, bolts and nuts. All specials like cated, specials, if used. shall be paid under the relevant items.

### **5.2 WELDED JOINTS**

The surface preparation and the precautions to be taken for butt welding shall be as per manufacturer's recommendations.

### **5.3 FLANGED JOINTS**

All special fittings such as tees, bends, 'Y' piece, cross piece, reducers etc. shall have ends and flanges. All pipes entering the chambers shall have pipe ends and flanges for connecting to flanged end specials. All the joints, special fittings inside the chambers shall be flanged joints for facilitating inspection and maintenance as shown in the drawings. The flanged ends shall be connected with adequate G.I. nuts and bolts with 3 mm thick neoprene gasket in between to prevent leakages. The end work shall be carried out according to specifications mentioned above and also as per manufacturer's recommendation. The pipe line shall be laid only by skilled workmen having extensive experience in laying of HDPE pipe line under pressure. If necessary they shall be tested before qualifying themselves for executing the job. The pipes shall be handled with extreme care while laying inside the S.W. pipes so that no cracks or defects, unnoticeable are formed or the S.W. Pipeline is disturbed causing damage to joints.

The entire pipe line all special fittings and every joint shall be tested for a pressure of 9 kg/sq.cm. (II/ 2 time the working pressure) and any leakages or defects etc. shall be made good immediately to the satisfaction of the Engineer. Their testing shall be done at the Contractor's expenses including apparatus for testing, provision of water etc. and the rates quoted shall cover all the above work.

### **5.4 MODE OF MEASUREMENT**

The High density polyethylene (HDPE) pipe line shall be measured in meters excluding the special fittings along the Centre line. The rates quoted for the pipes and specials shall be inclusive of all cost, cutting, welding, testing apparatus, neoprene gaskets, nuts and bolts etc. complete. The contractor should properly work out the number and type of special fittings required in the job from the drawing and the cost of which shall be included in the rate quoted for laying the HDPE pipes and specials. No extra claim on any account shall be entertained than the rate quoted for the items in the schedule.

## **6. SPECIFICATION FOR LAYING OF SEWER LINE**

### **6.1 LAYING:**

The laying of pipes shall be done as per IS : 4127-1983. The pipes shall be laid to the exact slope and the sockets shall be at the inlet ends. The pipe between the manholes shall be laid truly in a straight line without vertical or horizontal undulation. The body of the pipe shall for its entire length rest on an even bed of concrete and all places shall be excavated in the concrete to receive the socket of the pipe.

After satisfaction testing is over the S.W. drainage line will be covered with 100 mm thick cement concrete 1:4:8 (1 cement : 4 course sand : 8 graded aggregate of 40 mm max. size) around the pipe. All the concreting shall be done as described under the specifications. The pipe shall be of 'AA' class.

### **6.2 JOINTING**

The stoneware pipes shall be cement jointed as approved by the Authority.

#### **(i) Material for cement joints :**

The materials shall consist of the following :

- a. Spun yarn or tarred gaskets.
- b. Cement as per IS : 269-1976, IS : 1489-1976.

c. Sand as per IS : 1542-1977

**(ii) Caulking of yarn or gasket**

In each joint, spun yam soaked in neat cement slurry or tarred gasket shall be passed round the joint and inserted in it by means of a caulking tool. More skeins of yam or gasket shall be added if necessary and shall be well caulked. Yarn or gasket so rammed shall not occupy more than one fourth of the depth of socket.

**(iii) Caulking of cement mortar**

Cement mortar 1:1 shall be slightly moistened and carefully inserted by hand in to the remaining space of the joint after caulking of yarn or gasket. The mortar then shall be caulked into the joint with a caulking tool. More cement mortar shall be added until the space of joint has been completely filled with tightly caulked mortar. The joint shall then be finished off neatly outside the socket at an angle of 45 degree.

**(iv) Curing**

The cement mortar joints shall be cured at least for seven days before testing.

### **6.3 TESTING**

After the cement mortar has time to set up the pipes shall be tested in length in between manholes. In the lowest manhole a plug shall be inserted. The distance in the pipe at the upper manhole shall be fixed with a filling pipe with a right angle bend and an air cock. The length of the pipe shall then be filled with water by means of pipe connection on the upper disc. The air cock in the upper disc shall be kept open while the pipe line is being filled, to permit this escape of air when the pipes have been filled with water and air excluded, the air cock shall be shut and water shall be poured into a conical filler attached to the testing and filling pipe of the disc in the upper manhole until the water remain in the filler. The tunnel end of the filling pipe shall then be raised and fastened so that the height of the surface of water in the filler above the invert of the pipe is 6 feet which will be the usual test pressure for stoneware pipes.

The test will be for ten minutes. The fall of water level is allowed @ two litres per cm dia of pipe per km. length of pipe line. If it is found that certain pipe joints are leaking the water shall be drained off and joints rectified.

After the joints and pipes have been proved to be water tight they shall be bedded in cement concrete if specified to the extent of one half of the external diameter of the pipes or as directed. The concrete being made to slope away towards the sides of the foundation bed. Refilling shall be done with selected material and shall be done in layer not exceeding 230 mm thick material, consolidated and rammed properly as specified.

### **6.4 MEASUREMENT**

The contractor's rate shall be per meter of the pipe laid including laying of pipe, fixing, testing and refilling etc.

## **7. SPECIFICATION FOR MANHOLE CHAMBER/INSPECTION CHAMBER**

### **7.1 GENERAL:**

The item pertains to the provisions of inspection chamber/manhole chamber of brick masonry of the internal size specified in the item and of required depth including cement concrete foundation. Cement concrete channels corresponding to the size of pipes. The brick masonry and plastered inside, outside and all exposed

surfaces with C.I. cover at top weighing not less than 75 kg./120 kg. as specified. This items shall be subjected to the general specification.

## **7.2 CONSTRUCTION**

Manhole chamber/Inspection chamber shall have internal dimensions 900 mm x 450 mm as specified depth a bed foundation of I.C./M.H. shall be 150 mm thick 1:4:8 cement concrete (1 cement: 4 coarse sand : 8 graded stone aggregate of 40 mm nominal size). The brick masonry shall be done according to the specifications and conforming to I.S.: 1077. The brick corbelling at top shall be clear opening of 900 mm x 450 mm . The wall of internal manhole shall be plastered inside, outside and all exposed surface with cement mortar 1:4 (1 cement: 4 coarse sand ) 20 mm thick with a floating coat of neat cement. The channel of benching shall be done in cement concrete (1:2:4) and laying as per drawing and rendered smooth with a neat cement. Foot rest shall be fixed in masonry weighing not less than 3.50 kg. of each, 300 mm apart vertically and stagger laterally and shall project 100 mm beyond the surface of wall. The top foot rest shall be 450 mm below the manhole/ inspection cover. Foot rest shall be painted with coaltar. The portion embedded in the masonry shall be painted with thick cement slurry before fixing details footrest and fixing are shown in the drawing.

## **8. SPECIFICATION FOR CONICAL MANHOLE:**

Conical manhole chamber shall have internal dimension of 900 mm at bottom and 525 mm at top. The manhole shall be built on a bed of cement concrete 1:4:8 (1 cement: 4 coarse sand : 8 graded stone aggregate of 40 mm nominal size) the concreting shall be done according to the specification. The thickness of the bed concrete shall be 230 mm leaving 150 mm offset around outside of brick masonry. The brick masonry wall shall be 300 mm thick in cement mortar 1:6 brick masonry shall be done according to specifications and conforming to I.S.: 1077 and shall be finished to necessary shape. The cement plastering shall be done according to the specifications. The wall of manhole shall be plastered inside, outside and all exposed surface with cement mortar 1:4 (1 cement: 4 coarse sand) 20 mm thick finished with a floating coat of neat cement. The channel of benching shall be done in cement concrete 1:2:4 and laying as per drawing and rendered smooth with neat cement. Foot rest shall be fixed in the masonry and weighing not less than 3.50 kg. of each, 300 mm apart vertically and stagger laterally and shall project 100 mm beyond the surface of wall. The top foot rest shall be 450 mm below the manhole cover. Foot rest shall be painted with coal tar, the portion embedded in the masonry shall be painted with thick cement slurry before fixing. Details of foot rest and its fixing should be as shown in the drawing.

## **9. MEASUREMENT**

Measurement shall be for the number of chambers constructed.

## **10. C.I. FRAME COVER AND STEPS**

C.I. frame and cover shall be of best casting M/s. Ashok Irons Manufacture or equivalent and of weight specified. The rate includes fixing of C.I. frame and cover in cement concrete 1:2:4 Frame and cover shall be painted with two coats of anti-corrosive bitumastic paint.

## **11. OVERHEAD WATER TANK**

Overhead water tank should be one piece high density polyethylene tank, moulded to seamless perfection. They should be leak proof and rust proof. Capacity of the tank should be as specified in the items. They should be Sintex or equivalent make.

The rate shall include providing, hoisting and erecting the water tank, providing and fixing ball valves of best quality, top cover, inlet, outlet, overflow and all other necessary fixtures as required by Engineer.